

USE OF MOBILE AND FIXED RADIOTELPHONE FOR  
SUBSCRIBER SERVICE AND FOR OPERATION AND MAINTENANCE

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1. GENERAL

1.1 This material provides REA borrowers, consulting engineers, and other interested parties with information pertaining to the purchase and use of radiotelpone equipment. It describes the operation of both dispatch and dial radiotelpone systems and recommends the type of operation for specific uses. It contains a discussion of system design considerations, information to be submitted to the FCC, and guidelines for justifying its procurement.

1.2 This section replaces Section 940, Issue No. 1, dated October 1959. The revision describes new developments in mobile telephony and provides additional information for the planning and engineering of radiotelpone systems.

2. APPLICATION

2.1 Subscribers may be served by radiotelpone in vehicles and at remote fixed locations which cannot economically be served by land line facilities.

2.2 A telephone company may use radiotelpone as a tool in the construction, operation, and maintenance of its plant.

3. OPERATING FREQUENCIES AVAILABLE FOR USE OF TELEPHONE COMPANIES

3.1 Telephone Maintenance Radio Service

3.11 Available frequencies are listed in FCC Rules, Part 11, Subpart P - Telephone Maintenance Radio Service. These allocations lie in the 25 to 50 MC band, 150 to 160 MC band and 450 to 460 MC band. Exact frequencies are listed in paragraph 11.754 of the FCC Rules, Part 11. A user of radio is required to have a copy and to be familiar with the applicable rules. Part 11 is included in Volume V of the FCC Rules and Regulations and can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for \$2.50.

3.12 The frequencies available for this service may be used for communications incident to the technical or engineering aspects of construction, repair, maintenance or efficient operation of communications common carrier rights-of-way, plant facilities, and station equipment. They may not be used to serve subscribers.

3.13 Before a frequency in the Telephone Maintenance Radio Service will be granted by the FCC additional information regarding frequency coordination must accompany the application (see Appendix II).

### 3.2 Domestic Public Radio Services

3.21 Available channels consisting of pairs of frequencies are listed in the FCC Rules, Part 21, Subpart G - Domestic Public Mobile Radio Service. These allocations lie in the 25 to 50 MC band, 150 to 160 MC band, and the 450 to 460 MC band. Exact frequencies are listed in Section 21.501 of the FCC Rules, Part 21. A user of radio is required to have a copy and to be familiar with the applicable rules. Part 21 is included in Volume VII of the FCC Rules and Regulations and can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for \$2.

3.22 The frequencies listed under paragraph 21.501, Part 21, Domestic Public Land Mobile Radio Service, are available primarily for mobile subscriber use, but may be used to serve fixed subscribers provided no harmful interference is caused to other mobile systems. They may also be used for operation and maintenance of telephone facilities on a secondary basis, that is, in addition to serving subscribers.

3.23 There is no frequency coordinating committee for this radio service; however, the FCC will advise of frequencies presently available in any particular area. It is the responsibility of the applicant to apply for a channel which will not cause harmful interference to systems of other telephone companies using radio in the Domestic Public Radio Service.

## 4. DESCRIPTION OF DISPATCH TYPE RADIOTELEPHONE SYSTEM

4.1 This type of system consists of a base station with operator on duty at the control point and mobile units installed in vehicles. Dispatch operation is permitted under both FCC services listed in paragraphs 3.1 and 3.2.

4.2 The base station may be located in the telephone company business office or warehouse with its antenna mounted on a structure on top of or adjacent to the building. This is a local control type of operation and the least expensive to purchase and install. Where conditions prohibit the use of the locally controlled base station, a remotely-controlled base station may be installed. The location of the office with respect to the surrounding terrain usually dictates whether or not a local control or remote control type of operation will be used. In order to cover a wide area it is necessary to place the antenna at high above surrounding objects and terrain as economically feasible. The cost of achieving the desired height may be greatly reduced by locating the station on a hill or the highest elevation near the office, because towers are expensive. When this approach is used, it will be necessary to connect the base station to one or more remote control consoles at the desired location. This connecting facility normally consists of one pair of conductors, or it may be a carrier or radio circuit. Careful consideration should be given to a remote base station location in view of the cost of the connecting facility, availability of commercial power, and access by vehicle.

4.3 The mobile unit consists of a transmitter-receiver assembly in a cabinet usually located in the trunk of a passenger automobile or mounted in a weatherproof cabinet on a truck. It may be mounted under or behind the seat in the cab where space is available. The controls consist of a panel on which there is the power-on switch and volume control, squelch control, power-on pilot lamp, and transmitter-on pilot lamp. A palm-held microphone or a handset is located where it is convenient to the driver and a loudspeaker is mounted where it can best be heard under high noise levels.

4.4 A dispatch system normally uses the push-to-talk technique in each direction of transmission. While this may appear awkward to the beginner, it will become commonplace with a little experience. Most communications can be carried out within a few seconds since there is no lost signaling time.

4.5 The Telephone Maintenance Radio Service permits operation on a single frequency or a pair of frequencies. Single frequency operation allows all stations (base and mobile) to monitor the channel and to communicate with one another. This is very important in any service operation since it keeps personnel informed at all times when using their radio. It is especially important where there exists a need for coordinated effort among all radiotelephone-equipped vehicle operators and their supervisor, as is generally the case during and after widespread damage of facilities. Furthermore, the vehicle operators may communicate directly with one another independent of the base station. This feature is particularly important in the event of service interruption to the base station. When this happens, the supervisor may carry on his duties using a radiotelephone-equipped vehicle. Where transmission coverage becomes a problem, a mobile radiotelephone may be connected to the base station antenna and used as a temporary base station. All of these features are of prime importance in the event of emergency and therefore the single frequency dispatch type of operation is recommended for use in the operation and maintenance of telephone plant. The FCC Rules also provide for two-frequency operation with the base station operating on a frequency available for assignment to base and mobile stations and the mobile stations operating on a frequency available for assignment to mobile stations only.

This mode of operation permits the base station to act as a mobile repeater, that is, all mobile transmissions are automatically retransmitted by the base station. This type of operation gives much wider mobile-to-mobile communications which is advantageous for telephone systems serving large areas. When good maintenance and auxiliary power are available to the base station, this type of system is recommended because it will give a superior service over that mentioned above. However, it must be remembered that the entire system is dependent upon the base station.

4.6 The illustration in Figure 1 on page 4 is a diagram of a single frequency dispatch type of system.

4.7 Dispatch service may be offered to subscribers using frequencies in the Domestic Public Radio Services. This type of service would ordinarily be rendered during a limited number of hours a day as determined by demand considerations since it requires the presence of a dispatcher at the control point. The dispatcher can relay messages to and from mobile and/or land line subscribers and no interconnection to the telephone system is necessary. Such service might include relaying calls from the office of a physician, veterinarian, sheriff, school, etc., to the respective vehicles of the subscriber. Radiotelephone mobile subscribers are not permitted to communicate with one another except through the associated base station. Two frequencies are used for each channel in the Domestic Public Radio Services; therefore, direct communications between mobile units cannot be accomplished. A switch may be installed at the base station or control point which will permit the base station to operate as a mobile relay station, i.e., message received from a mobile unit can be retransmitted simultaneously by the base station. Thus, mobile unit operators may communicate with one another as long as they are within range of the base station. Telephone company operation and maintenance vehicles may share the channel with subscribers.

## 5. DESCRIPTION OF DIAL RADIOTELPHONE OPERATION

5.1 This type of equipment consists of a base station with associated signaling and control equipment connected to a dial central office, and mobile and fixed rural subscriber radiotelephones equipped with signaling and control apparatus for communicating through the base station and dial central office.

5.2 The base station may be located in the central office equipment building or at a remote site. The logic involved in choosing the proper location is the same as discussed in paragraph 4.2. An equivalent four-wire circuit is required for connecting the remotely located base station with the associated dial control equipment in the central office equipment building. The equivalent four-wire circuit may consist of two metallic circuits, a carrier or multiplex channel, or a radio link.

5.3 The mobile unit consists of the conventional transmitter-receiver assembly with additional equipment for dialing through and receiving ringing from the base station and central office equipment. The controls and accessories consist of a handset and dialing instrument, with on-off key switch; and pilot lamps to indicate power-on, transmitter-on, and busy circuit condition. Some equipment is provided with a call indicator lamp which lights when that particular subscriber is called and remains lighted until the handset is removed. A bell or buzzer is provided to sound at intervals similar to land line operation.

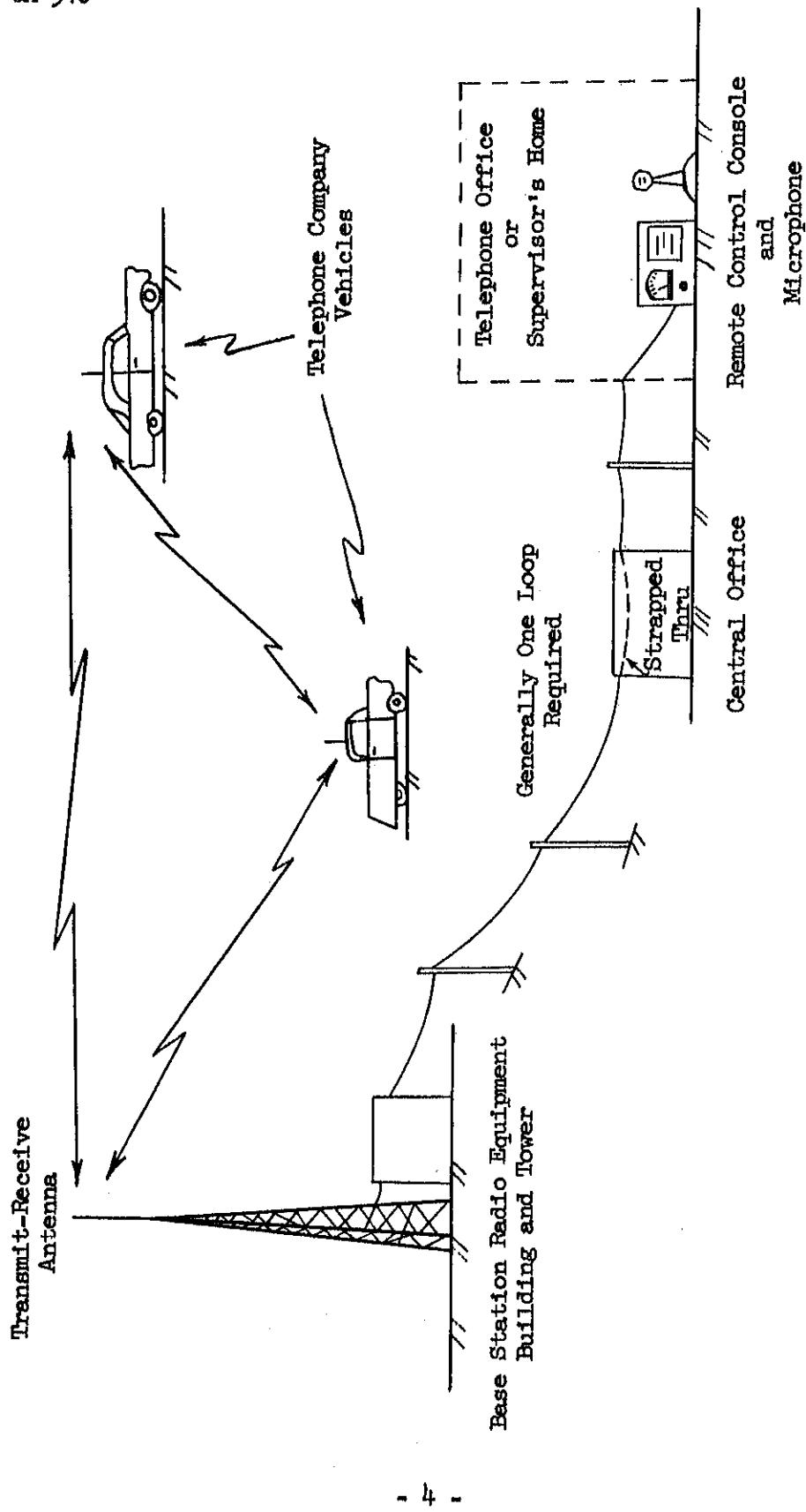


Diagram of a Typical Single-Frequency Dispatch Radiotelephone System

Figure 1

5.4 The base station transmitter and receiver operate simultaneously and provide full duplex service. Most subscriber stations employ the push-to-talk technique as used in the two-way lispacth radio. Some suppliers are furnishing full duplex mobile and fixed subscriber stations which permit the user to be interrupted by the land line party while the radio subscriber is talking. Even in this type of unit the push-to-talk button is retained for making revertive calls and to conserve battery power in mobile units.

5.5 Since each radio channel in the Domestic Public Radio Services consists of two frequencies, one for transmitting and one for receiving, communications between radiotelephone subscribers (revertive calls) must go through the base station. This is accomplished by allowing the base station transmitter to repeat all intelligence as it is received by the base station receiver.

5.6 Dial radiotelephone operation is recommended for service to subscribers. It is the only method of providing 24-hour radiotelephone service in unattended dial offices. It may be used to provide service to vehicles of physicians, veterinarians, taxis, business firms, etc. It may be used to provide service to residence, ranches, and resorts in remote locations where construction of wire-line facilities is impractical, and it may be used to establish temporary service in emergencies to new subscribers or to subscribers whose service has been interrupted.

5.7 A subscriber having a fleet of 5 or more vehicles should not share a channel with regular subscribers. An operation of this type thrives on high channel usage particularly through revertive calls. A radio channel is a party line and such use may discourage other subscribers from continuing the service.

5.8 Dial radiotelephone equipment may be installed in the telephone company's vehicles for use in the construction, operation and maintenance of its plant on a secondary basis. Guidelines for arriving at the optimum utilization of the channel and the economic feasibility in planning radiotelephone systems are discussed in Appendix I.

5.9 Figure 2 on page 6 is a diagram of a dial radiotelephone system.

#### . COMPATIBILITY PROBLEMS ASSOCIATED WITH DIAL RADIOTELEPHONE SYSTEMS

6.1 Some users of mobile dial radiotelephone may wish to obtain service in areas of other mobile radiotelephone systems and users of non-dial (manual) mobile units may desire service from dial radiotelephone system. Since different types of signaling are used by the suppliers of dial radiotelephone equipments and non-dial mobiles have no outgoing signals which are recognized by any type of dial radiotelephone base station, acute problems of compatibility are present.

6.2 The United States Independent Telephone Association (USITA) has defined compatibility in three categories as "A," "B," and "C".

6.21 Compatibility "A" is the minimum degree. It provides for manual acceptance and completion of calls initiated by mobiles of any type. That is, the mobile unit can only make outgoing calls.

6.22 Compatibility "B" includes "A" plus the capability of selectively calling mobiles equipped with 600-1500 cps decoders which is common to all manual type mobiles. In other words, any mobile equipped with a 600-1500 cps decoder may receive as well as initiate calls through an operator.

6.23 Compatibility "C" includes "B" plus the provision for full dial operation with suitably equipped mobiles. In other words, the ultimate.

6.24 All three degrees of compatibility presuppose that the mobile unit will operate on the same radio frequency channel as the base station through which it desires to communicate.

#### 5.3 Equipment Available for Providing Compatibility

5.31 Suppliers of the dial radiotelephone systems are providing Revert-to-Operator Panels which permit mobile units to meet compatibility "A." Some suppliers provide an Operator Access Panel which offers compatibility "B" when the foreign mobile unit is equipped with a 600-1500 cps decoder and when the operator has full supervision of the control terminal. The 600-1500 cps decoder may be added to the mobile unit if it is not an integral part of the mobile signaling equipment. There is nothing available to provide compatibility "C;" furthermore, there is nothing foreseen

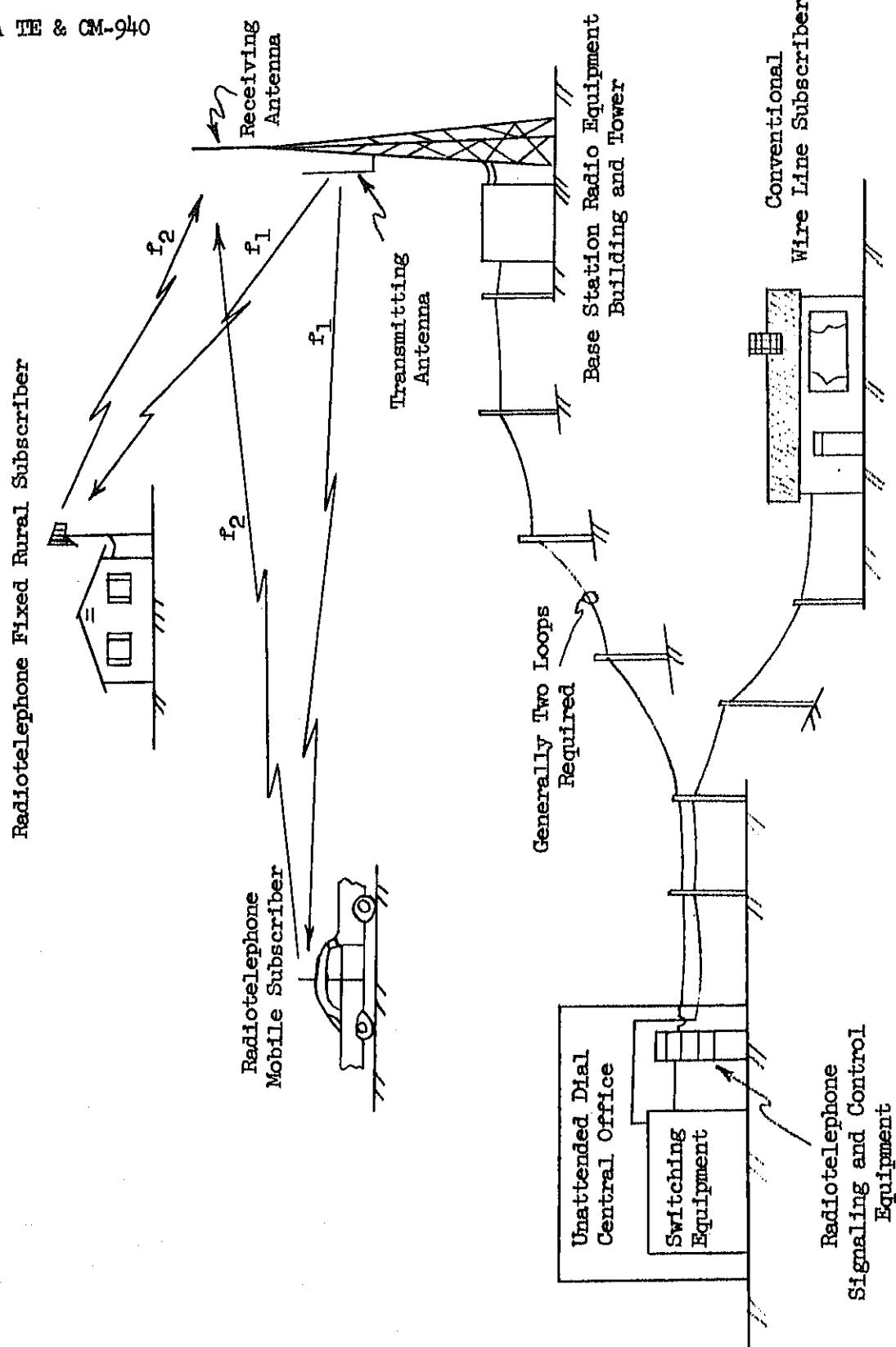


Diagram of a Typical Dial Radiotelephone System

In the future which will provide this degree of compatibility. Figure 3 on page 8 illustrates how the Revert-to-Operator and Operator Access Panels operate.

6.32 The Revert-to-Operator Panel is a device associated with the dial control terminal which, upon receipt of about ten to fifteen seconds of unmodulated carrier or any carrier having tones incompatible with that particular dial system, will automatically dial "0" and access an idle trunk to the toll center. The toll operator, not a Mobile Service Operator, answers and completes the call as would be done when a land line subscriber dials "0." This equipment does not contain the feature required for the operator to initiate a call to a mobile unit but it does satisfy the conditions for compatibility "A."

6.33 The Operator Access Panel operates on the same principle as the Revert-to-Operator Panel on calls originated by the mobile unit. It also contains the feature required for an operator to initiate calls to a mobile unit via a special circuit which provides absolute control of the dial radio terminal. This equipment is designed to accept dialing signals from the operator, convert them, when necessary, to the five digit code presently used by manual as well as some dial systems, store this information, and transmit the signals repeatedly until the mobile unit answers or until the operator abandons the call. The Operator Access Panel can provide compatibility "B" if it is controlled by the operator via a special trunk.

6.4 REA borrowers are being requested by some connecting companies to install these features so that their manual mobile subscribers may obtain service through the borrower's dial radiotelephone system. While these devices are capable of rendering a valuable service, they have inherent disadvantages which can become quite serious. They are described as follows:

6.41 When a foreign mobile unit initiates a call to a local subscriber, two toll trunks are required since the operator must signal the called party over a second trunk. Before equipment is purchased to provide this service, consideration should be given to the addition of toll trunks to handle the increase in traffic.

6.42 An agreement with the connecting company must be negotiated along with a thorough explanation of the operation before this arrangement is implemented, since it places an added burden upon all of the operators at the toll center. Furthermore, operator handling of calls of this type is somewhat different from that of calls to and from land line telephones because the foreign mobile is unable to transmit an "on-hook" signal. Upon completion of a call this signal must be artificially provided by a device associated with the base station equipment. This can be accomplished by the "lost call timer" which is usually adjusted to operate 2.5 minutes after the last transmission from the mobile unit. This means that the operator will continue to see a dark lamp on the trunk toward the mobile. When she challenges and does not get a reply, she may conclude that there is a "permanent" on the trunk and take it out of service. Since every operator at every position will handle these calls, thorough training is a "must."

6.43 Since this equipment operates upon the presence of unmodulated carrier, it is subject to false seizures from non-dial equipped mobile units as well as dial equipped units associated with another base station or from extraneous radio signals from other sources. There may be an intolerable degree of interference which can keep the base station and a toll connecting trunk tied up needlessly, plus a constant harrassment of the operators.

6.5 Since these problems are inherent in this method of operation and the situation is bound to get worse as more mobile systems go into operation, continued use may adversely affect the progress of dial mobile service; therefore, REA recommends against the purchase and installation of these applique panels until a satisfactory solution has been worked out.

## 7. COMMERCIALLY AVAILABLE RADIOTELEPHONE EQUIPMENT

### 7.1 Dispatch Radiotelephone Equipment

7.11 A number of manufacturers build and sell dispatch radiotelephone equipment which is a type accepted by the FCC (all transmitters employed must meet the FCC type acceptance requirements) and meets all technical requirements and specifications of the Electronics Industry Association. There are no REA specifications for dispatch radiotelephone equipment. However, REA may require field tests of any new type of equipment manufactured by suppliers which have equipment already approved by REA and any equipment supplied by a manufacturer which has not previously participated in the REA program.

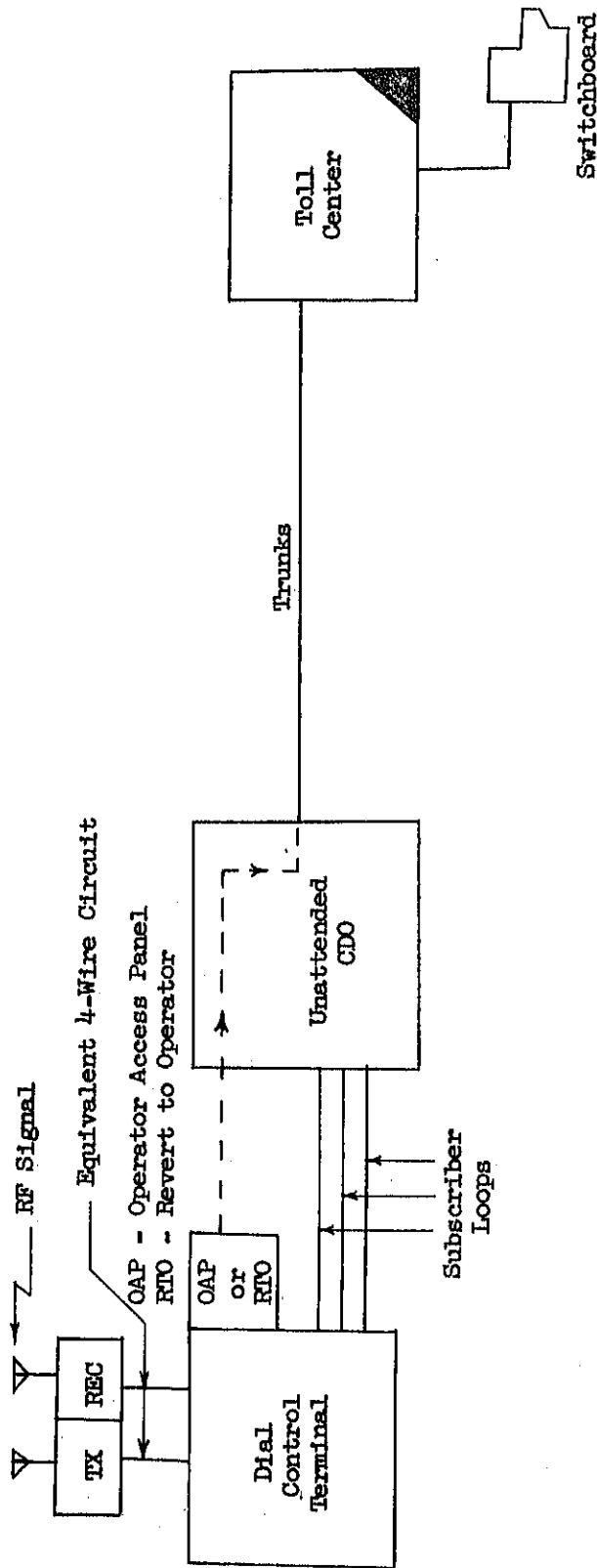


DIAGRAM OF TYPICAL ARRANGEMENT FOR SERVING  
FOREIGN MOBILES IN A DIAL RADIOTELEPHONE SYSTEM

FIGURE 3

7.12 Many types of equipment are available. Sizes of base stations generally range from 50 to 250 watts rf power output. Mobile units are generally manufactured in sizes from 10 to 100 watts rf power output with vibrator or transistor power supplies. Transistors are replacing most tubes in mobile equipment. Transistorized equipment (not to be confused with equipment having only transistorized power supply) has a very low standby power drain. It is particularly recommended for vehicles which remain parked while the radio is in use for a considerable period of time such as line trucks used in construction work.

## 7.2 Dial Radiotelephone Equipment

7.21 Some radio manufacturers and suppliers build and sell dial radiotelephone equipment developed to REA specifications. The radio equipment is generally conventional dispatch type equipment with the dialing and signaling features added and is somewhat more expensive than the conventional dispatch type.

# 8. SYSTEM DESIGN CONSIDERATIONS

## 8.1 Telephone Maintenance Radio Service

8.11 Choice of operating frequency depends upon the terrain and the coverage required. Frequencies in the low band (25 to 50 MC) are best suited for wide coverage, 40 to 50 miles, especially over hilly terrain. However, these frequencies are subjected to "skip" interference, i.e., interference from stations thousands of miles away. While this interference can be a nuisance, the operational capabilities may outweigh the disadvantages. Equipment suppliers ordinarily have available built-in or auxiliary equipment which helps to remove this interference. Many users of radiotelephone choose the low band because of the operational advantages with respect to useful service range in spite of the "skip" interference which is sporadic.

8.12 Where the desired service range is confined to 25 to 35 miles and the terrain is relatively flat, frequencies in the 150 to 160 MC band are recommended. These frequencies are relatively free from the long distance "skip" interference. Although the range between base stations and mobile units is somewhat less than in the 25 to 50 MC band, this gap can be narrowed by using higher gain antennas which are available at these frequencies.

8.13 Frequencies in the 450 to 460 MC band are not generally adequate for rural use and are not recommended for use by telephone borrowers. Frequencies in this band should be used only as a last resort when all other channels have been taken, and after the supplier has guaranteed a reasonable range of coverage. This type of equipment is somewhat more expensive than that which operates in the other two bands.

8.14 A clear channel for operations and maintenance is not always desirable. Where a neighboring telephone company operates a radio system on the same channel, important benefits may be realized by either or both companies. In the event of serious damage to facilities one telephone company can join forces with the other in restoring service. The joint effort would be greatly enhanced by their ability to communicate with one another by radiotelephone. Under normal conditions the channel is only used periodically in the operation and maintenance of telephone plant; therefore, there should be no serious conflict in traffic generated by small fleets.

## 8.2 Domestic Public Radio Services

8.21 Since frequencies allocated for this service are primarily for subscriber use, they should be as free as possible from interference; hence, the 150 to 160 MC band is recommended. The antennas used for mobile units in this band are much shorter and will make a better appearance in subscribers' vehicles.

8.22 Frequencies in the 450 to 460 MC band may be used for fixed rural subscriber stations when all available 150 to 160 MC channels are occupied to full capacity.

## 8.3 Transmitter RF Power and Antenna Requirements

8.31 High gain antennas and low loss coaxial cable transmission lines between the transmitter and receiver and the associated antenna(s) of the base station are recommended since they increase both the talk-out and talk-back ranges. Increasing the power of the base station transmitter will increase only the talk-out range, i.e., transmission from the base station to the mobile units. In

general a 50 watt base station can communicate with a 25 watt mobile unit in a properly engineered system. When a mobile unit is in an area subjected to high electrical noise, its receiver may become desensitized to the point where it cannot receive the base station, even though the base station can receive the mobile unit. This condition frequently arises where roadside electric power lines radiate interference. Some users of radio elect to increase the power output of the base station to overcome the electrical noise; this, however, is not recommended. In most instances the local power company will cooperate by taking corrective measures toward eliminating the source of the interference as it also affects reception of standard radio and television.

8.32 When two antennas are used, one for transmitting and one for receiving, the vertical separation must be sufficient to minimize desensitization of the receiver while the transmitter is operating. A single antenna may be used if a diplexer is provided which provides sufficient isolation between the transmit and receive frequencies. This arrangement should provide a more uniform coverage than the two-antenna system; that is, the talk-out and talk-back range should be about equal throughout the radio service area. The base station antenna(s) should be located where the electrical noise level is low in order that the full sensitivity of the receiver can be realized. Since most mobile transmitters are rated at one half the power of the base station transmitter, the base station receiver sensitivity must be adjusted to operate at a lower input level to overcome the 3 db difference in order that reciprocity of transmission may be realized. Figure 4 on page 11 illustrates the different receiver input levels for achieving a desired coverage.

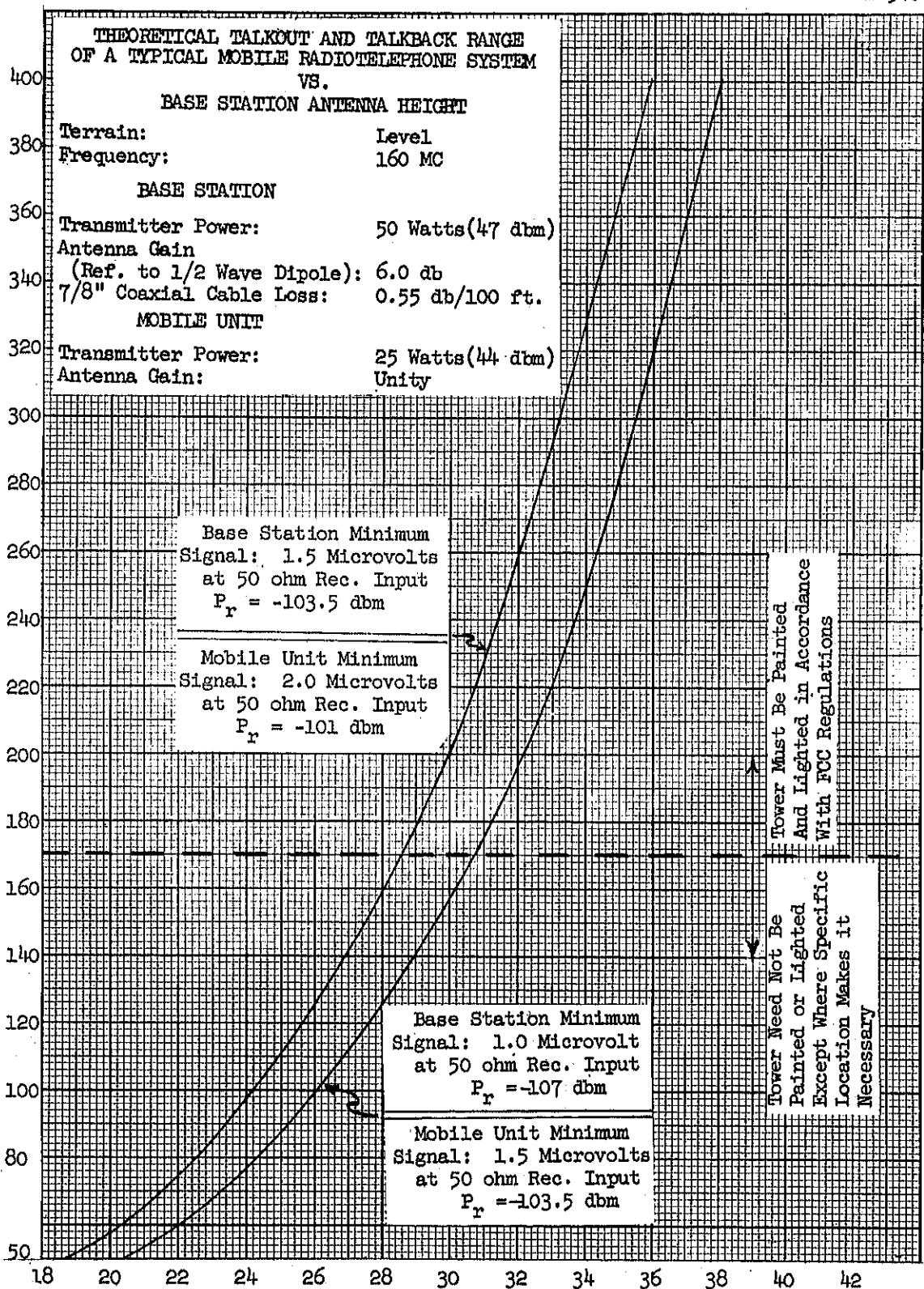
8.33 Careful consideration should be given to the tower height requirements for a desired service range. Ground elevation, water towers, grain elevators, tall buildings, and existing antenna towers may offset the need for a new antenna tower. All possible uses of the above means should be explored before purchasing a tower. A wood pole may be sufficient when erected on a hill top. If an existing structure which already has a radio installation is considered, the borrower's engineer should work with the radio equipment supplier to investigate the possibility of interference from the existing radio equipment and vice versa before a second base station is installed near existing equipment using that structure. In general an overall height (including top of antenna) of 170 feet will provide a 30-mile range of reliable communications over level terrain using frequencies in the 150 to 160 MC band. Where frequencies in the 25 to 50 MC band are used, the range will be somewhat greater—in the order of 40 to 50 miles. Towers having an overall height in excess of 170 feet are required to be painted and lighted in accordance with Part 17, Subpart C, Section 17.21 of the FCC Rules. A tower under 170 feet in height may also require painting and lighting due to its location. Applicant should consult the FCC Rules for details. In addition to the FCC Rules, the Federal Aviation Agency requires information on structures which may affect the use of navigable air space. This subject is covered in REA Bulletin 340-6 (Telephone), "Structures That May Affect the Use of Navigable Airspace."

8.34 It is difficult to predict the range of coverage of a radiotelephone system located in hilly terrain. Sometimes there are enough radiotelephone installations (taxicabs, police, utilities, etc.,) in the vicinity to provide sufficient information for determining the expected coverage of a proposed installation. A radiotelephone system should not be over-engineered to guarantee against a few "dead spots" in the useful service range.

8.35 Figure 4 on page 11 shows the theoretical range in miles of reliable communications over level terrain which can be expected of a radiotelephone system using frequencies in the 150 to 160 MC band. Calculations for the curves were based on the use of a 50 watt base station transmitter and a 6.0 db gain antenna. Coaxial cable loss with increase in tower height was included in the calculations. A unity gain antenna having a height of six feet was used for the mobile units. The range in miles is calculated for two grades of service. The 1.0 microvolt signal at the mobile unit should be ample for operation and maintenance service; whereas the 2.0 microvolt signal offers a slightly better signal-to-noise ratio for subscriber service. Detailed information showing the required coverage should be submitted as shown in Appendix V.

8.36 In general a somewhat greater range can be realized than shown in Figure 4. However, the graph illustrates the relative differences in ranges which can be expected using different antenna heights. An increase in tower height from 150 feet to 300 feet may more than triple the cost of the tower while the increase in range is in the order of 10 percent. As mentioned in paragraph 8.33, towers having overall heights in excess of 170 feet are required to be painted and lighted regardless of their location. This constitutes an additional original investment and the annual cost for maintenance and power consumption is quite high; furthermore, the licensee assumes additional responsibilities in complying with FCC and FAA requirements concerning tower lighting and painting.

TOWER HEIGHT - FEET



RANGE - MILES  
Figure 4

## 9. INSTALLATION AND MAINTENANCE

9.1 Proper installation of radiotelephone equipment is extremely important in achieving satisfactory operation. It is recommended that the borrower contract with the equipment supplier for a complete installation. While there may be a number of subcontractors which will perform the various jobs, the radiotelephone equipment supplier is responsible to the borrower for the entire system installation and the borrower is thereby assured of clear cut responsibility for an installation to its satisfaction.

9.2 There may appear to be a savings to the borrower through its undertaking of parts of the construction. However, this places a share of the responsibility on the borrower and leaves questions regarding the guarantee of proper system operation. The apparent savings may prove to be costly, apart from the problems created in deciding where to place the responsibility.

9.3 The radiotelephone equipment should be maintained under contract by the supplier for at least one year from the time of installation. This is particularly important when the more complex dial radiotelephone equipment is used. If the borrower has personnel holding a first or second class radio operators license, it may assume the maintenance responsibilities at such time as the personnel has become familiar with the equipment. This should result in a saving. In any event the borrower (holder of FCC authorization) assumes full responsibility to the FCC for the proper installation, operation and maintenance of the equipment.

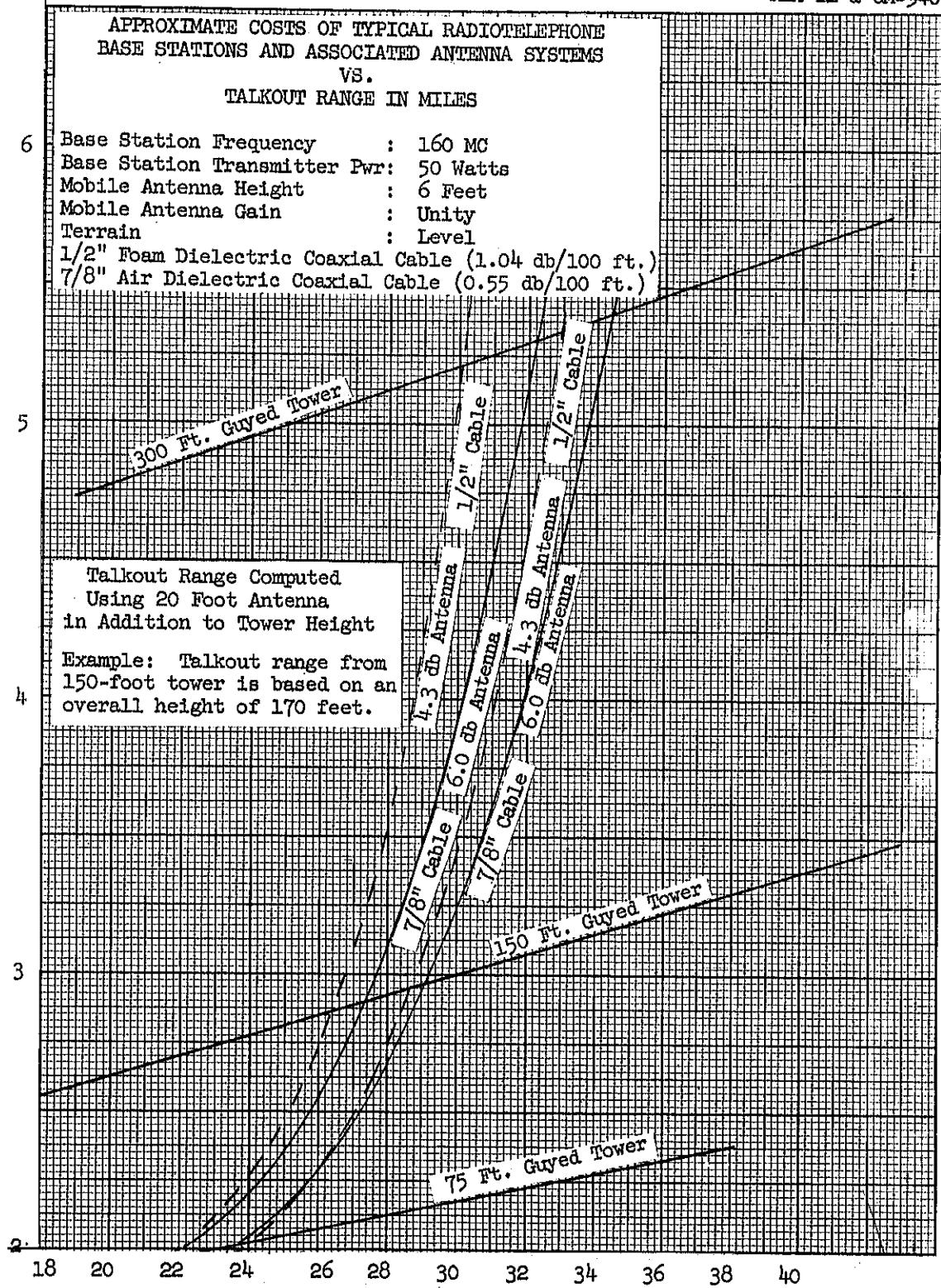
## 10. APPROXIMATE PRICES OF TYPICAL RADIO EQUIPMENTS

10.1 Base Station (Radio)	\$2,000
10.2 Central Office Dial Control Terminal	\$4,000
10.3 Mobile Equipment	
10.31 Dispatch (Single Channel)	
10.311 Tube Type	\$ 600
10.312 Transistorized Type	\$ 750
10.32 Dial (Single Channel)	
10.321 Tube Type	\$1,000
10.322 Transistorized Type	\$1,200
10.4 Multi-channel mobile units--add \$50 per channel to single channel price	
10.5 Towers	
10.51 150-foot steel tower--erected	\$2,000
10.52 The size and type of the tower must be tailored to each installation. Their cost varies widely depending on the height, whether guyed or self-supporting, and ice and wind loading design; prices for different sizes and types are not given here. Figure 5 on page 13 shows the approximate costs of typical base stations with the associated antenna systems having different height towers. <u>The cost of the dial control terminal is not included.</u> A radio equipment or tower supplier should be consulted for specific cost information.	

## 11. COST STUDY

11.1 Each borrower should make a study to determine whether or not the initial and annual costs of radiotelephone equipment can be justified for its own operation and maintenance (O&M) vehicles and also, for the vehicles of its subscribers who can afford to pay the relatively high costs involved or dial radiotelephone service.

COST, THOUSANDS OF DOLLARS



TALKOUT RANGE TO THE 2.0 MICROVOLT CONTOUR - MILES  
(Measured Across 50-ohm Mobile Receiver Input)

FIGURE 5

1.2 Two sample cost studies and a discussion on the use of a separate dispatch channel are presented in Appendix I to serve as a general guide to the cost of furnishing radiotelephone service for O&M and for subscriber vehicles. The studies cover dispatch service for O&M vehicles and dial service for subscriber vehicles. Studies of specific situations, using actual costs and annual carrying charges, may show substantial variations from these sample studies, as will be apparent from the following description of the assumptions underlying these studies.

1.21 Initial Cost - An average of current bid prices has been used based on the need for a 150-foot steel tower. Bids for specific jobs may vary with suppliers' design procedures and so with differences in the mounting of the antenna. In some cases the antenna may be mounted on existing structure or it may require a much higher structure than is assumed in the sample studies.

1.22 Maintenance - For the comparatively simple dispatch equipment, a monthly maintenance charge of \$25 is used for the base station and \$7.50 for each O&M vehicle for the average situation. For the more complex dial equipment these costs become \$35 and \$10 respectively. These figures present the average of current maintenance contract costs. To these costs an estimated monthly base station power charge of \$6 is added.

1.23 Depreciation - A composite rate of 9 percent is used for all items rather than several rates to cover the variable average service life of the system.

1.24 Other - For O&M vehicles a charge of 4.0 percent is made against the initial cost of a dispatch system irrespective of whether the O&M vehicles are actually operated on a dispatch basis or not. This rate comprehends 2 percent interest, 1.2 percent insurance for all items in the system and 0.8 percent taxes. For subscriber vehicles a charge of 7.0 percent of initial cost is assumed, the 3 percent increase being added to reflect a minimum return necessary before income tax for a borrower seeking a return on equity capital. A nominal \$10 per year administration charge is added for each subscriber vehicle account.

1.25 Additional Considerations for O&M Service - No allowance has been made for increased efficiency of installation and maintenance personnel due to more effective control of their activities with radiotelephone service. It goes without saying that the savings from more effective control must at least equal the fairly substantial annual costs of providing radiotelephone service on the O&M vehicles. No allowance has been made for a possible saving of toll charges where such charges would otherwise be incurred when communicating with men in remote parts of the area. In such cases the justification of radiotelephone service will be made more easily.

#### INFORMATION PERTAINING TO FCC AUTHORIZATIONS

1 Before purchase and installation of radiotelephone equipment, proper authorizations must be obtained from the FCC. Application for authorization to construct and operate a station in Telephone Maintenance Radio Service differs from that required in the Domestic Public Radio Services. Sample applications and other information which may be helpful in applying for the proper authorizations are contained in Appendices II, III, and IV.

2 Telephone Maintenance Radio Service

21 Application for authority to operate a station in this service should be made by filing FCC Form 400 with the FCC. FCC Form 400-10 contains detailed instructions for completion of FCC Form 400. A copy of this form should be obtained along with FCC Form 400.

22 A station license is generally all that is required in this service. A construction permit may be required if the tower requires painting and lighting. Under certain conditions a construction permit and station license are included on the same authorization which is a part of application FCC Form 400.

23 The licensee must notify the FCC Engineer-in-Charge of the local FCC Radio District of the date on which the transmitter will be placed in operation, giving name of licensee, station identification, call sign, and operating frequencies. This notification should be made in writing on or before the day on which operation is commenced. Section 11.52 of the FCC Rules, Part 11 should be referred to for detailed instructions.

### 12.3 Domestic Public Radio Services

12.31 The initial authorization required in these services is a construction permit for the base station and associated mobile units. Where there is a need for rural subscriber stations at fixed locations, applications should be filed with the FCC for specific stations. Applications should be made by filing FCC Form 401 with the FCC (See Appendix III).

12.32 If after receiving a construction permit, it is determined that certain changes are necessary, such as frequency, station location, antenna height, etc., a modification of the original construction permit must be filed on FCC Form 401. No changes can be made until a modified construction permit is received from the FCC (Section 21.29 (c)).

12.33 Construction permits are normally valid for a period of eight months. Extensions may be granted by filing FCC Form 701 at least 30 days prior to the expiration date if the equipment cannot be installed within the 8-month period. However, some phase of construction should be started within 60 days from the date of permit (Section 21.30). This may include items such as radio building, tower, wire line connecting facilities, etc.

12.34 The FCC Engineer-in-Charge of the local FCC Radio District in which the station is located must be notified in writing at least two days in advance of the date on which the transmitter will be tested, giving company name, call sign, frequencies, station location, and time and date on which equipment tests will be made. No service to subscribers may be furnished through the radiotelephone equipment during the test period. Equipment tests normally shall not exceed 10 days, but, upon request to FCC, may be extended when warranted.

12.35 Upon completion of construction of a base station or permanent rural subscriber station, and when the equipment is operating satisfactorily, FCC Form 403 must be filed for a station license. This must be done prior to the expiration date of the construction permit (Section 21.29 (e) and 21.212).

12.36 After filing FCC Form 403, service tests and service to subscribers may commence and continue until a grant of the license application is made or otherwise disposed of by the FCC. The FCC Engineer-in-Charge must again be notified in writing at least two days before the station commences service tests.

## 13. BASE STATION OPERATION REQUIREMENTS

### 13.1 Telephone Maintenance Service

13.11 Operators of base stations are not required to have technical knowledge; however, they must hold a Restricted Radiotelephone Permit which is valid for life. This permit may be obtained by filing FCC Form 753-1 with the FCC office in the local FCC Radio District.

13.12 Possession of a Restricted Radiotelephone Operator Permit does not permit the holder to make any transmitter adjustments. Any adjustments must be made by a person holding a First or Second Class Commercial Radio Operator License.

13.13 A licensee of a radio station in this service is required to maintain technical and operational records. Detailed information is given in the FCC Rules, Part 11, Subpart D.

### 13.2 Domestic Public Radio Services

13.21 Part 21, Section 21.208 (g) of the FCC Rules requires that an operating log be kept on calls by an operator at the control point. When an application for a dial system is filed, waiver of this rule should be requested if it is not possible to have an operator on duty and in charge of the station. However, a technical log is required to be maintained by the licensee. Section 21.208 (e).

13.22 FCC Rules require each station to be identified at the end of each conversation or at least every half-hour (Section 21.213 (a)). This is done automatically for a dial type base station by automatically transmitting the station call sign in International Morse Code (Section 21.213 (d) (1)) or by recorded voice announcement. When the disconnect signal is received from a mobile unit, land line station, or the "lost call" timer, the identification is sent out before the station goes

air. Since all mobile and fixed station transmission are retransmitted by the base station, it is desirable to request a waiver from the FCC to eliminate the requirement that each mobile and general subscriber identify itself individually (Section 21.213 (b) (1) and (2)).

FCC Rules 21.118 (d) and 21.205 (i) require that a licensed operator be on duty at a control point in charge of the station's operations. When a dial system is contemplated, waiver of this requirement should be requested since the primary purpose of dial radiotelephone equipment is to provide means for a telephone company, without switchboard operators or specialized radio technicians, to give 24-hour radiotelephone service to the public. Since technical knowledge of radio equipment is not necessary to obtain a Restricted Radiotelephone Operator's Permit, it is recommended that telephone company supervisory personnel obtain such a permit which is valid for life. Paragraph 12.118 (d) explains how this may be obtained.

APPENDIX I

## SAMPLE COST STUDIES FOR DISPATCH AND DIAL RADIOTELPHONE SERVICE

1. Dispatch Service for Five O&M Vehicles

Item	Initial Cost	Annual Cost				Cost/Mobile Year Mo.
		Maint.	Depre. %	Other**	Total	
Base Station Tower*	\$2,000	\$370 /1 80	\$180 180	\$ 81 81	\$ 631 341	
Connecting Facilities /2	-	-	-	-	-	
5 Mobiles	3,000	450	270	122	842	
Total	\$7,000	\$900	\$630	\$284	\$1,814	\$363 \$30.25

\*If tower serves another channel above total costs become:

Total	\$6,000	\$860	\$540	\$244	\$1,644	\$329 \$27.40
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\*\*"Other" includes interest 2%, insurance 1.2%, and tax 0.8%.

2. Dial Service for Ten Subscriber Vehicles

Item	Initial Cost	Annual Cost				Cost/Mobile Year Mo.
		Maint.	Depre. %	Other**	Total	
Base Station Tower*	\$ 6,000 /3	\$ 420 /1 80	\$ 540 180	\$ 432 141	\$1,453 401	
Connecting Facilities /2	-	-	-	-	-	
10 Mobiles	10,000	1,200	900	805	2,905	
Total	\$18,000	\$1,770	\$1,620	\$1,369	\$4,759	\$476 \$39.65

\*If tower serves another channel above costs become:

Total	\$17,000	\$1,730	\$1,530	\$1,299	\$4,559	\$456 \$38.00
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\*\*"Other" includes interest and return 5%, insurance 1.2%, and tax 0.8%; also, \$10 per station for administration.

/1 Maintenance cost includes \$70 for power at base station.

/2 This item covers the connection between a remote base station and the remote control console(s) where dispatch service is employed, and between a remote base station and associated central office equipment where dial service is employed. The cost of this item is not included in these sample studies, since the type used and distance involved will vary widely with each installation. However, this cost should be included in any specific study made to accurately reflect all annual costs.

/3 Includes an allocation of cost for associated central office line and switching equipment.

3. Use of Separate Dispatch Channel

Where radiotelephone service is desired for regular subscriber service and for telephone company O&M vehicles there will be some overall economy in small installations by foregoing the more efficient dispatch service for O&M work and sharing the dial channel with regular subscribers.

O&M vehicles there is no saving in initial cost and a monthly saving of \$0.75 to \$1.16 per vehicle. In view of the possible service criticism by the regular subscribers arising from the use of the channel, it would appear that a separate dispatch channel could be justified for one O&M vehicles. At the other extreme with as few as 3 O&M vehicles, the monthly cost savings for regular subscribers ranges from \$3.02 to \$3.42 which may possibly be an effective offset to service criticism.

more difficult to establish guide lines for the in-between case of 4 O&M vehicles. Even though O&M vehicles are contemplated, should service criticism become serious there might be quite a bit in changing out the dial sets for dispatch sets in the O&M vehicles in situations where the dial or no opportunity to reuse the dial sets for subscriber service.

In general the tendency will doubtless be to favor the use of a separate dispatch channel for O&M vehicles using the comparatively slow dial service only where necessary to help prove in the dial for regular subscribers. The monthly cost chargeable to each O&M vehicle is affected very little by the change from dial to dispatch operation. The monthly cost per vehicle of \$27.40 for 5 vehicles (Study No. 1) increases to \$30.80 for 4 vehicles and to \$36.35 for 3 vehicles.

APPENDIX IIAPPLICATION FOR FCC AUTHORIZATION  
IN THE TELEPHONE MAINTENANCE RADIO SERVICE

Application for authority to operate a radio station in this service differs from that required in the Domestic Public Radio Service. Frequency coordination is required in this service and evidence supporting this coordination must be submitted along with the application. This information may be supplied using either of the two methods below:

- (a) A study showing all users of radio within 75 miles operating on the requested frequency or within 30 kilocycles of that frequency and a report of the possible extent of harmful interference to stations within the frequency and mileage limits indicated. Such report must show names of all stations considered and distance between proposed area and their areas, or
- (b) a letter from the "Telephone Industry Radio Coordinating Committee" which has been established to perform the study required in (a).

The services of this committee are available to any eligible applicant for authorizations in the Telephone Maintenance Radio Service. When corresponding with this committee, the preferred frequency should be given along with a request for the committee's recommendations for a suitable frequency. The exact geographical coordinates of the proposed base station, elevation above mean sea level, and height of tip of antenna above ground should be included in the request.

Correspondence to this committee should be directed to:

Secretary  
Telephone Industry Radio  
Coordinating Committee  
438 Pennsylvania Building  
Washington 4, D. C.

Compliance with paragraph (b) is recommended since it assures cooperation with the industry and eliminates a time consuming survey on the part of the prospective user of radio.

A completed sample application FCC Form 400 using fictitious names and places is contained in this exhibit. This sample application is intended to serve as a guide. Applicant must give the appropriate information in each entry and is cautioned not to copy information which may be inaccurate under the particular circumstances.

The information required for completion of this form is straightforward. However, it is recommended that the applicant obtain FCC Form 400-10 which contains detailed instruction for filing FCC Form 400. The entire form is not visible in the sample since the top half of the form contains built-in multi-carbon copies. A worksheet is attached to the form which should be filled out in pencil. After it is determined that all entries are correct, the form should be completed (on both sides) using typewriter.

When the antenna is to be more than 170 feet above ground (except when it is to be less than 20 feet above an existing man-made structure) or near an airport, FCC Form 401-A must be filled out in triplicate and submitted along with the FCC Form 400. This also applies when the antenna is to be installed on a tower already requiring painting and lighting. Applicant should consult the FCC Rules for details.

Application(s) must be signed and submitted to the Federal Communications Commission, Washington 25, D. C. Notarization or signature is no longer required.

Attachment

Form Approved United States of America Budget Bureau No. 55-1182.2 <b>FEDERAL COMMUNICATIONS COMMISSION</b>																	
<p>authorization permits the use of only such transmitters as are specified under "General Conditions" and those appearing in the Commission's "List of Equipment Acceptable for Licensing" and designated for use in the particular radio service indicated in Item 4(a) of this application.</p>																	
Frequency (Mc)	(b). No. of transmitters		(c). Emission	(d). Maximum power input (watts)													
.985	1	10	20F3	600													
<b>APPENDIX II - (Continued)</b>																	
<p><b>EXAMPLE (Names of company, people, and locations are fictitious)</b></p> <p><b>2(a). Name (see instructions)</b> <b>East-West Telephone Company, Inc.</b></p> <p><b>(b). Mailing address (number, street, city, zone, state)</b> <b>Sometown, North Dakota</b></p> <p><b>Location of transmitter(s) at a fixed location</b> <b>Number and street (or other indication of location)</b> <b>1 mile north of Sometown off Hwy. 401</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">City</td> <td style="width: 15%;">County</td> <td style="width: 15%;">State</td> </tr> <tr> <td>Sometown</td> <td>Jones</td> <td>N. Dakota</td> </tr> <tr> <td>Altitude</td> <td>Longitude</td> <td></td> </tr> <tr> <td>47 07</td> <td>102 45</td> <td>30 W</td> </tr> </table>						City	County	State	Sometown	Jones	N. Dakota	Altitude	Longitude		47 07	102 45	30 W
City	County	State															
Sometown	Jones	N. Dakota															
Altitude	Longitude																
47 07	102 45	30 W															
Term of authorization: This authorization effective _____ and will expire 8:00 A.M. EST. _____ and is subject to further conditions as set forth on reverse side. If the station authorized herein is not placed in operation within eight months this authorization becomes invalid and must be returned to the Commission for cancellation unless an extension of completion date has been authorized.																	
By direction of the <b>FEDERAL COMMUNICATIONS COMMISSION</b>																	
																	
SECRETARY																	
FOLD HERE																	
<p>applicants a corporation or of an alien or of a foreign government? If answer is "Yes", explain on the reverse of this page. Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>whether applicant is (Check one)  <input type="checkbox"/> Individual    <input type="checkbox"/> Partnership    <input type="checkbox"/> Association    <input checked="" type="checkbox"/> Corporation</p> <p>Governmental Entity <input type="checkbox"/></p> <p>applicant is a non-governmental corporation (if not Item 10; if an unincorporated association fill out Item 20, on the reverse side of this page.)</p> <p>applicant is an individual.          applicant a citizen of the United States? Yes <input type="checkbox"/> No <input type="checkbox"/>          If applicant is not a citizen of the United States? Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p>communication services to be received from or rendered to other person (see instructions)? If "Yes", name of person is Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p>If the applicant owns the radio equipment Yes <input type="checkbox"/> No <input type="checkbox"/>          (If the answer to either (a) or (b) is "No", see instructions.)</p> <p>each functional system diagram showing details of proposed radio system and include such other supplementary data as required by specific rules.</p> <p>It is proposed to use a transmitter which does not appear on the Commission's "List of Equipment Acceptable for Licensing", or if the transmitter is listed but not in the "List of Equipment Acceptable for Licensing" service, in Item 4(a) of this application, describe such transmitter in detail. (See instructions.)</p> <p>statement of eligibility</p> <p>is provided for in FCC Rules, Part 11, subpart P, 11.751 (a) See reverse side          (Use space on the reverse of this page)</p>																	
<p>16(a). Application for (Check one)  <input checked="" type="checkbox"/> New station    <input type="checkbox"/> Assignment of Authorization  <input type="checkbox"/> Modification    <input type="checkbox"/> Reinstatement of expired authorization    <input type="checkbox"/> License to cover CP</p> <p>(b) If for modification, state modification proposed</p> <p>(c) If this application refers to a presently authorized station, give call sign</p> <p>(d) Give points of communication (call signs)</p> <p>(e) Are you presently authorized for any other stations in the service indicated in Item 4(a)? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>17. If antenna will be mounted on an existing radio tower, Give call signs of users</p> <p>18. Will antenna extend more than 20 feet above the ground or natural formation, or more than 20 feet above an existing man-made structure on which it will be mounted? If "Yes", give the following:          (a) Give height and type of existing structure on which antenna will be mounted. <b>150 foot steel, guyed tower</b>          (b) Distance to nearest aircraft landing area <b>21, 120 feet</b>    (c) Elevation of ground, at antenna site, above mean sea level <b>2500 feet</b></p>																	
<p>he statements made in the application and attached exhibits (including exhibits, if any, incorporated herein by reference) are considered material representations, and all the exhibits material part hereof and are incorporated herein as if set out in full in the application.</p> <p>applicant certifies that he has a current copy of the Commission's Rules governing the radio service named in Item 4 (a) above.</p> <p>applicant waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by licensee or otherwise, and requests an authorization in accordance with this application.</p>																	
<b>East-West Telephone Company, Inc.</b>																	
Applicant (Must agree with name as shown in Item 2(a)).																	
<p>scribed and sworn to before</p> <p>6th day of October 1959</p> <p>John Jones          (or name and title of other person competent to administer oaths)</p> <p>November 22, 1960</p>																	
<p>By: John Doe          (Designate appropriate classification below)</p> <p><input type="checkbox"/> Individual Applicant  <input type="checkbox"/> Member of Applicant Partnership  <input checked="" type="checkbox"/> Officer of Applicant Corporation or  <input type="checkbox"/> Officer and Member of Applicant Association  <input type="checkbox"/> Official of Governmental Entity Competent under the jurisdiction to sign for the Applicant</p> <p>(OVRB)</p>																	

CONDITIONS OF GRANT

A. Subject to the provisions of the Communications Act of 1934, as amended, subsequent acts, treaties, and all regulations heretofore or hereafter made by this Commission, and further subject to the conditions and requirements set forth in this authorization the licensee or permittee hereof is authorized to use and operate the radio transmitting facilities herein described. This authorization shall not vest in the licensee or permittee any right to operate the station nor any right in the use of the frequencies designated in the authorization beyond the term hereof, nor in any other manner than authorized herein.

B. Neither this authorization nor the right granted herein shall be assigned or otherwise transferred to any person, firm, company, or corporation except by specific authorization of the Commission.

C. This authorization is issued on the licensee's representation that the statements contained in licensee's application are true and that the undertakings therein contained, so far as they are consistent herewith, will be carried out in good faith. The licensee shall, during the term of this license, render such service as will serve public interest, convenience, or necessity to the full extent of the privileges herein conferred.

D. This authorization is subject to the right of use or control by the Government of the United States conferred by Section 606 of the Communications Act of 1934, as amended.

FOR COMMISSION USE ONLY

D. If applicant is a non-governmental corporation (a) Under the laws of what State is it organized?	
North Dakota	
Is more than one-fifth of the capital stock of the corporation either owned of record or may it be voted by aliens or their representatives or by a foreign government?      Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Is any officer or director of such corporation an alien? If so, state name and position of each      Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
(b) Is applicant directly or indirectly controlled by any other corporation? If no, what is the name and address of the controlling corporation?      Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Under the laws of what State is it organized?	
Is more than one-fourth of the capital stock of the controlling corporation either owned of record, or may it be voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country?      Yes <input type="checkbox"/> No <input type="checkbox"/>	
Is any officer or more than one-fourth of the directors of such corporation an alien? If "Yes", state name and position of each, and state total number of directors      Yes <input type="checkbox"/> No <input type="checkbox"/>	
Is the above described controlling corporation in turn a subsidiary? If no, attach additional sheets answering the items in this paragraph for each company to and including the organization having final control.	
E. If applicant is an unincorporated association	
Number of members      Are any members aliens?      Yes <input type="checkbox"/> No <input type="checkbox"/> Number of aliens, if any	
Name and position of alien officers or directors, if any	

REMARKS AND ADDITIONAL DATA  
Sample Statement of Eligibility

The East-West Telephone Company, Inc. is primarily engaged in rendering wire-line service to the public for hire. It operates 12 exchanges throughout a rural area covering approximately 4000 square miles including the counties of Jones and Jackson. The system is comprised of 1600 miles of pole lines over which 2600 subscribers are served. The use of radio will permit maintenance vehicles to restore service to subscribers more quickly, particularly after facilities have been damaged by storms, floods, etc.

USE ADDITIONAL SHEETS IF NECESSARY

### APPENDIX III

**APPLICATION FOR FCC CONSTRUCTION PERMIT  
IN THE DOMESTIC PUBLIC LAND SERVICE**

Some borrowers have had difficulty in knowing what information to send to the FCC when applying for a construction permit and therefore some of the information that is generally overlooked is listed in detail. Much of the difficulty in supplying the desired information has arisen from the fact that Part 21 of the FCC Rules requests information in addition to that requested in FCC Form 401 and other information is sometimes required which is not requested in either. A borrower should submit information required to the best of its ability. If the FCC desires additional information, it will generally return the application with a letter outlining the specific additional information desired.

The following information and sample application is intended to serve as a guide. Applicant must give the appropriate information in each entry and is cautioned not to copy information which may be inaccurate under the particular circumstances.

The numbers preceded by 21 in the following comments refer to the contents to be included in the application as outlined in the specific paragraph in Part 21 of the FCC Rules; number not preceded by 21 refer to questions in FCC Form 401.

1. If application is from an association or corporation, the space for information regarding citizenship should be left blank.

2 & 3 Fill in the applicable information.

21.15(c) Submit as an Exhibit a certified copy of charter, acts of incorporation, or, if not a corporation, a copy of bylaws, articles of association or other documents to show that the company is authorized to operate as a communications common carrier. The name of the applicant should be listed according to instruction 4, page 5, of FCC Form 401.

4. Class of station would be Base and/or Mobile.

21.509(f)  
21.606(a) Since the system is to be installed primarily to provide service to mobile units, the nature of service will be Domestic Public Land Mobile.

21.610(b) If the application is for a subscriber station at a fixed location, such as at a remote residence, school, or ranch, the class of station should be listed as Rural Subscriber and the nature of service as Domestic Public Rural Radio.

Mobile units may be listed on the same FCC Form 401 with the base station, provided the information pertaining thereto is clearly evident and distinct from the information pertinent to the base station and make and type used for the mobile units should be indicated under question 13.

A separate Form 401 should be used for each Rural Subscriber Station at a fixed location.

The applicant's principal business should be listed as "Telephone Operating Company."

5. If the first question is checked "No" the balance of the questions under 5 should be left blank.

6, 7, & 8 Fill in the applicable information.

9. Two copies of the applicant's most recent balance sheet (within 90 days of the date of application) should be furnished and listed as an exhibit under 29. If the balance sheet does not indicate clearly the availability of funds to cover the purchase, a statement should be included giving details of the credit arrangement and the identity of the creditor.

21.15(d)

10. Fill in the applicable information.

11. Answer should be "yes."

12(1) Frequencies available for assignment are listed under Section 21.501(a) and (b). The base station frequency selected should be listed under 12(1) and the words "Base Station" written on the same line in the left margin. There is always a question as to what frequency should be selected for the base station. A frequency that is most commonly used in the state where the telephone company is located is probably the best selection if the distance between such station(s) and the applicant's station is great enough so there will be no overlapping of the areas covered. When there is a likelihood of some overlapping, a statement should be submitted to show what measures will be taken to avoid the occurrence of harmful interference between the two co-channel radio systems. This statement should be included as an exhibit.

If the application is also for mobile units, write the words "Mobile Stations" in the left margin 2 or 3 lines below the base station and list the mobile frequency associated with the base station plus any other frequencies which are likely to be used. In some cases a mobile subscriber may desire to transmit to the base station of a nearby telephone company which operates on a different channel than that used by the applicant.

12(2) Indicate as "unlimited."

12(3) This is generally answered as the plate power input such as 120 (PPI). This information will be furnished by the supplier of the transmitter.

12(4) This is generally "16F3;" for narrow-band equipment. This information should be obtained from the equipment manufacturer.

12(5) This is generally "300-3000" but it should be checked with the equipment manufacturer.

12(6) This should be left blank.

21.509(f) Points (or areas) of communication - The base station will transmit to Mobile Stations. If the applicant is serving or applying to serve rural subscriber stations over the base station in the Domestic Public Land Mobile Radio Service, the appropriate information should be entered. The area within which these stations will operate or the location of fixed stations should be indicated. The mobile units will transmit to the Base Station. While the mobile units may talk to other mobile units or to rural subscriber stations, such communications will be through the base station operating as a mobile relay station. If the application is for a rural subscriber station, the azimuth of the base or central office station (direction in degrees from true north, clockwise) should be given as well as the distance in kilometers between the stations. This should be included in the exhibit showing sketch of proposed rural subscriber station antenna installations. If the application is for a rural subscriber station, a statement should also be included as to why the service cannot be provided by wire line facilities and reasons why service to the rural subscriber stations through the base station will not affect, adversely, the availability or adequacy of service to mobile subscribers.

21.108  
21.609

13 & 14 The make and type number of the base station transmitter to be installed should be indicated. This information should be obtained from the equipment supplier. The number of mobile subscriber stations anticipated for installation within the license period, together with the make and type number should be indicated. Where the manufacturers have the data regarding the technical information on their equipment on file with FCC, type across the balance of the questions under 13 and 14 "Data on file with FCC." All transmitters used must be on the "type accepted" list for licensing under Part 21 of FCC Rules. This list is not available for public distribution, but is available for inspection in the offices of the FCC in Washington and its Field Engineering offices in various cities. The locations of these offices are given in each Volume of the FCC Rules and Regulations.

15(e) If a frequency meter is to be purchased, the manufacturer will supply the required technical information to be inserted under 15, c, d, e, and f.

If a qualified technician, such as someone in the area who maintains the transmitting equipment of the police, power company, etc., is to service the equipment, his name and address and class of radio operator license should be given. If a service technician, having a frequency meter is hired to maintain the equipment, he can supply the required technical information on the meter.

If a qualified service station, having frequency-checking facilities, is to maintain the equipment, the name should be listed under 15 b and items 15 c, d, e, and f, need not be answered. Service stations will supply a statement as to their qualifications. This should be included as an exhibit as outlined in Appendix IV.

The showing of technical qualifications also requires the applicant to state, when such is the fact, that it has a copy of Part 21 of the FCC rules, that it is generally familiar with the contents of the rules, and that it will keep abreast of all amendments to such rules. Further, it should state the measures to be taken to insure active day-to-day control over the radio facilities.

An estimate should be made as to the cost of the equipment to be installed initially. This should be broken down into the major items such as base station transmitter-receiver, mobile units, antenna installation (including tower) and installation labor. This should be included in an exhibit.

13 If the location of a transmitter for a permanent location cannot be indicated by street and number, some other description of its location should be given, such as "two miles south of city limits on U. S. Highway 29." The latitude and longitude should also be given. This can be obtained from Department of Interior topographic maps, FAA maps, etc.

Supply information when known. In addition, applicant should describe its proposed base station antenna and transmission line as shown in Exhibit No. 9 of Appendix IV.

20 5(f) If the antenna is more than 170 feet above ground (except when it is less than 20 feet above an existing man-made structure) or near an airport, FCC Form 401-A should be filled out in triplicate and attached as an exhibit. (See instruction 6, page 5 of Form 401.) This applies also if an antenna is to be installed on a tower already requiring lighting. If more than one licensee uses the same tower, supply information requested in Section 21.111.

4 0(4) If the application is for rural subscriber stations at temporary fixed locations, applicant should state that it is familiar with Section 21.610(4) and that the installations will be made in accordance with such rule.

If the application is for dial operation, check question 21 "no" and add the following comment: "No operator supervision except daily checks by responsible personnel." An explanation must be made under question 21(e) as to how the licensee intends to check the circuit for proper operation.

If the transmitter and its associated receiver are at the same location (as is generally the case) this question can be answered "same as transmitter."

The schedule of charges should be attached as an exhibit.

Leave blank.

Give definite facts such as--the stations (base, mobile and rural subscriber) will be in the public convenience, interest or necessity since it will provide telephone service to vehicles and remotely located subscribers who could not otherwise obtain any type of telephone service by conventional means. This information should be supplied in an exhibit. On a secondary basis, service may be provided to operation and maintenance vehicles which will result in better telephone service to all company subscribers. If the application is not accompanied by one or more applications for rural subscriber stations, reference to remotely located subscribers should be omitted even though there may be an intention to serve them at a later date.

21.609 If the application is for rural subscriber stations (i.e., stations at one location more than 6 months) show by comparison of initial cost, maintenance difficulties, etc., why it is impractical to serve the subscriber by wire line facilities. There should also be a statement showing that service to the fixed subscriber will not adversely affect the availability or adequacy of service to mobile subscribers.

26. Leave blank.

27. Some phase of construction must be started within 60 days after grant of a construction permit and all construction must be completed within 8 months after date of such grant. An extension may be granted if construction cannot be completed within that period.

28. Unless application is for an extension of time for construction, leave blank.

29. List all exhibits attached to application. If more space is needed use separate sheet of paper and label as an exhibit. All except the charter must be submitted in duplicate. If the same exhibit applies to more than one application, or if it is already on file from a previous application, reference may be made thereto by specific identifications and a statement that the same facts still apply (Section 21.15(b) (1) & (2)).

30. Application must be signed and submitted in duplicate with all exhibits to the Federal Communications Commission, Washington 25, D. C. Notarization of signature is no longer required.

Following, as a part of this appendix, there is attached an FCC Form 401 which has been filled out with the name of a fictitious company. The information is given as an example only. The actual facts relating to the proposed installation must be used in answering each question.

Attachment

## SAMPLE (Names of company, people and locations are fictitious)

FCC Form 401 June 1934		Form Approved Budget Bureau No. 52-R043,10	File No. _____ Call _____
United States of America Federal Communications Commission <b>APPLICATION FOR NEW OR MODIFIED RADIO STATION CONSTRUCTION PERMIT (Other Than Broadcasting)</b> <small>(Read Instructions on Page 5)</small>		Name of applicant (See Instruction 4) <b>East-West Telephone Company, Inc.</b>	
1. Is the applicant (Check one) Individual <input type="checkbox"/> Partnership <input type="checkbox"/> Association <input type="checkbox"/> Corporation <input checked="" type="checkbox"/>		Post office Address <b>Sometown, North Dakota</b>	
<small>(If applicant is a partnership above the following information for each member of the partnership)</small> Is applicant a citizen of the United States? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		4. Purpose of this application (See Instruction 1) a. Class of station <b>Base &amp; Mobile</b> b. Nature of service <b>Domestic Public Land Mobile</b> c. New station <input checked="" type="checkbox"/> d. Changes in existing station (File No. _____) Call _____ e. Modification of valid construction permit (File No. _____) Call _____ (of construction permit)	
<small>If citizenship is claimed by reason of birth, state Date of birth _____ Place of birth _____</small>		<small>If (d) or (e) have been checked, indicate nature of proposed construction</small>	
<small>If citizenship is claimed by reason of naturalization Date and place of birth _____ Date and place of issuance of final certificate of naturalization _____</small>		1. Replace transmitter <input type="checkbox"/> 4. Change location <input type="checkbox"/> 2. Add. transmitter <input type="checkbox"/> 5. Change antenna <input type="checkbox"/> 3. Increase power <input type="checkbox"/> 6. Other changes <input type="checkbox"/> <small>(Use separate sheet)</small>	
<small>If citizenship is claimed by reason of naturalization of a parent Name of parent _____ Age of applicant when certificate was issued _____</small>		What is applicant's principal business? <b>Telephone Operating Company</b>	
<small>Date and place of birth _____ Date and place of issuance of final certificate of naturalization _____</small>		5. If applicant is a corporation Is applicant directly or indirectly controlled by any other corporation? If "Yes", give name and address of such controlling corporation Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<small>Certificate number _____ Court authorizing issuance of certificate _____</small>		<small>Under laws of what State or country is corporation organized? (If application is for common carrier radio facilities, attach certified copy of Articles of Incorporation)</small>	
1. Is applicant a representative of an alien or of a foreign government? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> 2. If applicant is a corporation, including municipal corporation		<small>Is more than one-fourth of capital stock of such corporation owned of record or may it be voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country? Yes <input type="checkbox"/> No <input type="checkbox"/></small>	
<small>Under laws of what State or country is it organized? <b>North Dakota</b></small>		<small>Is any director or officer an alien? If "Yes", state name and position of each Yes <input type="checkbox"/> No <input type="checkbox"/></small>	
<small>If application is for common carrier radio facilities, attach copy of the charter, acts of incorporation, or articles of incorporation, certified by the legal custodian of such records, i.e., secretary of state, or other governmental official prescribed by the laws of the State of incorporation)</small>		<small>Is the above-described controlling corporation in turn a subsidiary? If "Yes", attach additional sheets answering Paragraph 5, inclusive, for each company to and including the organization having final control. Yes <input type="checkbox"/> No <input type="checkbox"/></small>	
<b>Charter attached (Exhibit #2)</b>		6. If application is made in behalf of an unincorporated association	
<small>Is more than one-fifth of capital stock owned of record or may it be voted by aliens or their representatives or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country?</small>		Purpose of the association _____ Number of members _____	
<small>Is any director or officer an alien? If "Yes", state name and position of each Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></small>		State number of alien members (if any) _____	
<small>State names and addresses of all stockholders owning and/or voting 10 percent or more of applicant's stock and percentage held by each</small>		<small>Is any director or officer an alien? If "Yes", state name and position of each Yes <input type="checkbox"/> No <input type="checkbox"/></small>	
<small>John Doe, Sometown, N. D. 40%</small>			
<small>James Jones, Sometown, N. D. 50%</small>			
<small>s stock to be sold after this permit is issued for purpose of raising money to construct and/or operate the proposed station? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></small>		<small>(Attach copy of the Articles of Association or bylaws, certified by an appropriate officer of the organization)</small>	

## FCC Form 401

Page 2

7. Is applicant directly or indirectly, through stock Yes  No   
ownership, contract, or otherwise, interested in  
the ownership or control of any other radio stations?  
If "Yes", state

Call Letters Location of stations

Has the applicant ever been directly or  
indirectly interested in the ownership or control  
of any radio stations other than those stated above? If "Yes", state

Class of station Exact name of licensee

(If a large number of stations, chain or otherwise, are involved, the number  
of each type may be listed in response to Paragraph 7)8. State applicant's relation to station (If applicant is to be neither owner or  
lessee, state nature of applicant's interest in use and control of station)

Applicant will be owner.

(If not owner, attach copy of agreement showing applicant's interest in  
station)

If applicant is not to be owner of station, who is?

Will applicant have absolute control of station, Yes  No   
both as to physical operation and service conducted?  
If "No", attach copy of any contract which may in any way  
affect applicant's right to do so.

9. State fully the facts showing applicant's financial ability to construct and  
operate this station.Latest balance sheet attached (Exhibit  
#3). (If balance sheet does not  
indicate the availability of funds,  
include statement giving details of  
credit arrangement and the identity of  
the creditor).(If application is for a station to be operated as a common carrier, attach  
the most recent balance sheet) -10. Has the applicant, or any person directly or Yes  No   
indirectly controlling the applicant, been  
finally adjudged guilty by any Federal court of unlawfully  
monopolizing, or attempting unlawfully to monopolize radio  
communication, directly or indirectly; through control of  
manufacture or sale of radio apparatus, exclusive traffic  
arrangement, or any other means, or of unfair methods  
of competition?11. Is applicant directly or indirectly engaged in Yes  No   
the business of transmitting and/or receiving  
for hire messages of any cable, wire-telegraph,  
or telephone lines or systems?

## 12. Frequency requested and particulars of operation of the proposed station

Frequencies (kc) (1)	Hours (2)	Maximum power (watts) (3)	Emission (4)	Modulating frequency cycles (5)	Transmission speed bauds (6)	Points of communication
Base Station 152,510	unlimited	120 (PPI)	16F3	300-3000		To associated mobile stations
Mobile Stations 157,770)	unlimited	60 (PPI)	16F3	300-3000		Base station
157,890)						

1. List frequencies separately.
2. Indicate as unlimited, day only, continuous, etc. (This item refers to intended hours of use of the specific frequency.)
3. Maximum carrier power into antenna, or maximum plate power input to the final radio frequency stage. (State which)
4. List each type of emission separately for each frequency. Describe special emission in space for remarks below. Additional information on frequency modulation when used including proposed band width, etc., shall be submitted.
5. Give maximum modulating frequency employed in normal operation opposite type of emission involved.
6. Give maximum transmission speed employed in normal operation opposite each type of emission involved. To convert transmission speed of Continental Morse to bauds multiply the number words per minute by 0.8.

REMARKS:

## 13. Description of transmitting apparatus proposed to be installed Base station, some make, type JA23

State number of transmitters, if more than one  
transmitter, identical in type, is to be installed

Make

10 Mobile, some make

Type or Model No.

JB26 &amp; JB27

(Where the manufacturer has filed with the Commission complete technical details, the balance of the data required under Paragraph 13 and Paragraph 14 may be omitted. In those cases where the transmitter cannot be adequately described below, a circuit diagram shall be submitted.)

Tube complement	Number and types of tubes	Normal plate current per tube	Plate voltage
Oscillator stage			
Intermediate stages	Date on file with FCC		
Final radio stage			
Modulator			

FCC Form 401		Page 3		
13. (Continued)		17. Proposed location of transmitter		
Type of oscillator circuit	Plate power supply for last radio stage	Portable <input type="checkbox"/>	Mobile <input checked="" type="checkbox"/> X	Portable-mobile <input type="checkbox"/>
Type or class of modulation	Rated Current _____ Rated Voltage _____	If permanently located at a fixed location give		
		State North Dakota	County Some County	
Which radio stage is to be modulated?	State maximum percentage of modulation	City or town 1 Mile North of	Street and number Sometown off Hwy. 401	
State maximum rated carrier power (Should not be exceeded by the power under Item 12(3).)	Indicate frequency range of the transmitter	North latitude 47° 07' 20"	West longitude 102° 45' 30"	
14. a. What apparatus is included as an integral part of the transmitter for automatically holding the frequency within the allowed frequency tolerance?		18. Give commercial or Government RECEIVING station antenna systems known to be located within 3 miles of proposed location of transmitter. None Base station antenna, some make, type 34; gain 3 db, transmission line 175 feet, 7/8" copper; power loss 0.8 db.		
b. Within how many cycles or within what percentage of the assigned frequency is this apparatus designed or guaranteed by the manufacturer to hold the operating frequency?		19. Will the antenna extend more than 20 feet above the ground or natural formation, or if mounted upon an existing man-made structure, will it extend more than 20 feet above such structure? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
c. State type, number, if any, and name of manufacturer of frequency-control apparatus		20. If the answer to the above question is "Yes", give the following:		
d. Is frequency-control apparatus automatically maintained at constant temperature? Yes <input type="checkbox"/> No <input type="checkbox"/>		Overall height above ground to tip of antenna 165 ft.	Distance to nearest aircraft landing area 21,120 ft.	
15. a. What provision will be made for measurement and periodic checking of the station frequency?  See Exhibit #4		Elevation of ground, at antenna site, above mean sea level 2500 ft.		
b. If a frequency measuring device is not to be installed, give name and address of frequency checking agency		List any natural formations or existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft and thereby minimize the aeronautical hazard of the antenna.  100-foot water tank located 200 yards east of proposed antenna tower location.		
(If frequency checking agency is shown above, the succeeding subparagraphs of this question are not to be answered)				
c. What type of frequency measurement or calibration apparatus will be used?		See instruction No. 6 in reference to conditions under which FCC Form 401-A must be submitted.		
d. Within how many cycles or within what percentage will this apparatus measure the frequency?		21. Is the transmitter to be operated with licensed operator on duty at a remote control point only? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> X (If "Yes", the following information must be furnished. No operator data required by this item is to be on duty at the transmitter except daily checks by responsible personnel.) supervision		
e. What methods will be used to check the calibration of this precision instrument?				
f. How often will this instrument be checked?				
16. Estimated cost to establish proposed facilities				
a. Transmitter (ready for service) \$ _____		g. Location of remote control point (If more than one remote control point is involved, attach supplementary sheet giving location of each remote control point, plan of operation, etc.) See Exhibit #6		
Other items (state the nature and amount applicable to each) \$ _____		State _____ County _____		
See Exhibit #5		h. City or town _____ Street and number _____		
TOTAL ESTIMATED COST \$ _____		i. What is the airline distance between transmitter location and remote control point?		
b. Applications for instruments of authorization by a radio telephone or telegraph common carrier involving expenditures in excess of \$10,000 shall include a statement showing the principal items of property and purchases represented by such costs. Within 90 days after completion of the construction requested herein, the applicant shall file with the Commission a summary of the expenditures made and the accounting performed therewith.		j. By what means will the transmitter be rendered inaccessible to unauthorized persons?  Enclosed in locked cabinet		
		d. Can transmitter be placed in an inoperative condition from the remote control point? Yes <input type="checkbox"/> No <input type="checkbox"/> Can be rendered inoperable by breaking the control circuit at the central office equipment located at 21 Main Street, Sometown, N. Dakota.		

FCC Form 401

## 21. (Continued)

e. Describe below the equipment to be used to enable the operator at the remote control point to determine when there is a deviation from the terms of the station license or when operation is not in accordance with the Commission's rules governing the class of station involved.

Telephone company supervisory personnel will periodically monitor the channel. See Exhibit #6. (Explain how, where, and how often in third paragraph of waiver request).

22. Location of receiving equipment associated with this station  
Same as transmitter

State	County
City or town	Street and number
North latitude	West longitude

List frequencies, call letters, and location of stations to be regularly received

In case of common carrier operating in either the fixed public or fixed public press services, state name of organization, agency, or person operating the receiving end of the circuit as required by regulations governing these services

23. Is station to be open to public correspondence? Yes  No   
If "Yes", state hours during which station will be open for such service

Unlimited

Will any charge be made for handling public correspondence? If "Yes", state schedules of charges? Yes  No

See Exhibit #7

(The statement of rates required herein does not constitute a filing of schedules of charges required by section 203 of the Communications Act of 1934, as amended, prior to commencing service.)  
State basis of division of charges with other stations

24. If station is to be used in the aviation service, will Yes  No   
the service of the station be available for any aircraft desiring to make use of it?

During what hours will station be open for communication with such aircraft?

25. Give definite facts why the operation of the station will be in the public convenience, interest, or necessity

See Exhibit #8

Page 4

26. If the application is for any class of station in the experimental service, attach supplementary statements as required for the particular class of station.

27. If application is for a new construction permit, the construction, if authorized, will be commenced by

Within 60 days after permit is received  
Construction will be completed by

Eight months after permit is received

28. If this application is for modification of construction permit and extension of time is required, applicant should answer the following:

a. Applicant requests that the date of required commencement of construction be extended to

b. That the date of required completion of construction be extended to

c. Applicant represents that this construction cannot be completed within the time specified in the existing construction permit due to

29. Any exhibits referred to herein and those attached hereto, described and identified as follows, are certified to be true and correct. (List here all exhibits attached to the application)

See Exhibit #1

30. The applicant waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests a construction permit in accordance with this application.

Dated this 6th day of October, 1962

East-West Telephone Company, Inc.

Applicant (Must correspond with that shown on Page 1)

By John Doe (President & Manager)

Designates by checkmark below appropriate classification

- Individual Applicant
- Member of Applicant Partnership
- Officer of Applicant Corporation or Association
- Official of Governmental Entity Competent under the Jurisdiction to Sign for the Applicant

Subscribed and sworn to before me

this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_\_

Notary Public

[REDACTED]

(Notary public's seal must be affixed where law of jurisdiction requires, otherwise state that law does not require seal.)

My commission expires \_\_\_\_\_

INSTRUCTIONS

1. This form is to be used when requesting a new or modified radio station construction permit in the services and for classes of stations as listed in Parts 5, 6, 7, and 9 of the Commission's Rules.

## Experimental (Part 5)

Class 1  
Class 2  
Class 3

## Aeronautical (Part 9)

Aeronautical land  
Aeronautical fixed  
Airdrome control  
Aeronautical utility land  
Aeronautical utility mobile  
Radio beacon  
Radio direction finding  
Radio range

## Fixed Public (Part 6)

Point-to-point telegraph  
Point-to-point telephone

## Localizer

Glide path

Marker

Ground control approach

Flight test

Flying school

Aeronautical public service

Civil air patrol

Aeronautical advisory

## Fixed Public Press (Part 6)

Point-to-point telegraph

## Agriculture (Part 6)

Point-to-point telegraph

## Domestic Public Land Mobile (Part 6)

## Maritime Stations on Land (Part 7)

Coast

(Public )

(Limited)

Marine utility

Radiolocation

Radionavigation

Marine fixed

2. Before this application is prepared applicant should refer to the applicable part or parts of the Rules and Regulations of the Commission, copies of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

3. Submit in duplicate direct to the Federal Communications Commission, Washington 25, D. C. Swear to one copy only. (If for an Alaskan station, submit in triplicate to Engineer in Charge, Seattle, Washington).

4. If a corporation, state corporate name; if a partnership, state names of all partners and the name under which the partnership does business; if an unincorporated association, state the name of an executive officer, the office held by him, and the name of the association. If this application involves a station that is now authorized, the name herein shown must correspond exactly with that shown on current authorization.

5. If any information called for by this application is already on file with the Commission, it need not be resubmitted, with this application provided sufficient reference is made to permit locating the information in the Commission's files, and provided further that a statement is made that there has been no change in the information since the date of filing. Reference to such information should indicate the file number of the application or other document with which or in which the information was filed. Such reference will be considered by the Commission to incorporate the documents or other material referred to in this application.

6. FCC Form 401-A, and required exhibits, shall be submitted in triplicate with this application in all cases when:

(1) The antenna structures proposed to be erected will exceed an over-all height of 170 feet above ground level, except that where the antenna is mounted on top of an existing man-made structure and does not increase the over-all height of such man-made structure by more than 20 feet, no Form 401-A need be filed, or

(2) The antenna structures proposed to be erected will exceed an over-all height of 1 foot above the established airport (landing area)\* elevation for each 200 feet of distance, or fraction thereof, from the nearest boundary of such landing area, except that where the antenna does not exceed 20 feet above the ground or if the antenna is mounted on top of an existing man-made structure or natural formation and does not increase the over-all height of such man-made structure or natural formation by more than 20 feet, no Form 401-A need be filed.

\* Landing area, as defined in Part 17 of the Commission's Rules: "Landing Area" means any locality, either of land or water, including airports and intermediate landing fields, which is used, or approved for use, for the landing and take-off of aircraft, whether or not facilities are provided for the shelter, servicing, or re-pair of aircraft, or for receiving or discharging passengers or cargo.

7. BE SURE ALL NECESSARY INFORMATION IS FURNISHED.

APPENDIX IV

LIST OF EXHIBITS WHICH SHOULD ACCOMPANY  
AN APPLICATION FOR CONSTRUCTION PERMIT  
FOR A RADIO STATION IN THE DOMESTIC  
PUBLIC LAND MOBILE SERVICE

Submit each in duplicate except charter

1. List of Exhibits per item 29.
2. Charter (only one (1) copy required) and bylaws (when they exist).
3. Latest balance sheet.
4. Method of Maintaining equipment including:
  - (a) Name and address of person or organization.
  - (b) Time required to reach base station from normal headquarters.
  - (c) Names of licensed personnel, type of license, and length of experience.
  - (d) Answers to question in item 15 where applicable.
  - (e) Copy of maintenance contract or agreement.
5. Equipment list and cost breakdown.
6. Waiver request (if any). See sample attached.
7. Schedule of charges.
8. Statement showing convenience and necessity including list of signed subscribers.
9. Sketch of proposed antenna installations. See sample attached.
10. Topographic map showing location of base station.
11. Copy of document giving right and access to property and/or facilities owned by another party (when applicable).

(Following, as a part of this appendix, there are attached sample Exhibits Nos. 1, 6, and 9 as represented on this list.)

APPENDIX IV - Continued

Exhibit #1 (Sample)

List of Exhibits Accompanying this Application  
Per item 29 of FCC Form 401

- Exhibit #2 Charter and bylaws.
- Exhibit #3 Latest balance sheet.
- Exhibit #4 Method of maintaining equipment.
- Exhibit #5 Equipment list and cost breakdown.
- Exhibit #6 Waiver requests.
- Exhibit #7 Schedule of charges.
- Exhibit #8 Statement showing convenience and necessity including list of signed subscribers.
- Exhibit #9 Sketch of proposed antenna installation.
- Exhibit #10 Topographic map showing location of base station.
- Exhibit #11 Copy of document giving right and access to facilities located on property owned by another party.

APPENDIX IV - Continued

## Exhibit #6 (Sample)

Sample Waiver Requests for Automatic Two-Way Dial Operation\*Station Identification 21.213(b) (1) for mobile units and 21.213(b) (2)  
for rural Subscriber Stations

Station identification will be given by automatic tone signaling as required under Section 21.213 (d) (1). This will be an audio tone keyed in International Morse Code so that the base station call sign will be transmitted at 25 words (or less) per minute or a recorded voice announcement at the end of the conversation just before the base station transmitter goes off the air. Since all mobile and rural subscriber transmission are automatically retransmitted by the base station and since each subscriber station is identified by telephone number, it is requested that the station identification of the base station be adequate for the system identification rather than having each mobile and rural subscriber unit identify itself by call sign or telephone number.

Operating Log - 21.208(g)

Since it is impracticable, economically, to provide operators in an automatic unattended dial telephone exchange to handle the limited number of mobile and rural subscriber radio stations in the area, an automatic dial-operated base station is the only method by which such radio service can be provided. Since it is impossible to keep a record of calls for this type of operation, we request that requirements for keeping an operating log of the calls be waived.

Control for Unattended Operation 21.118(d) and 21.205(i)

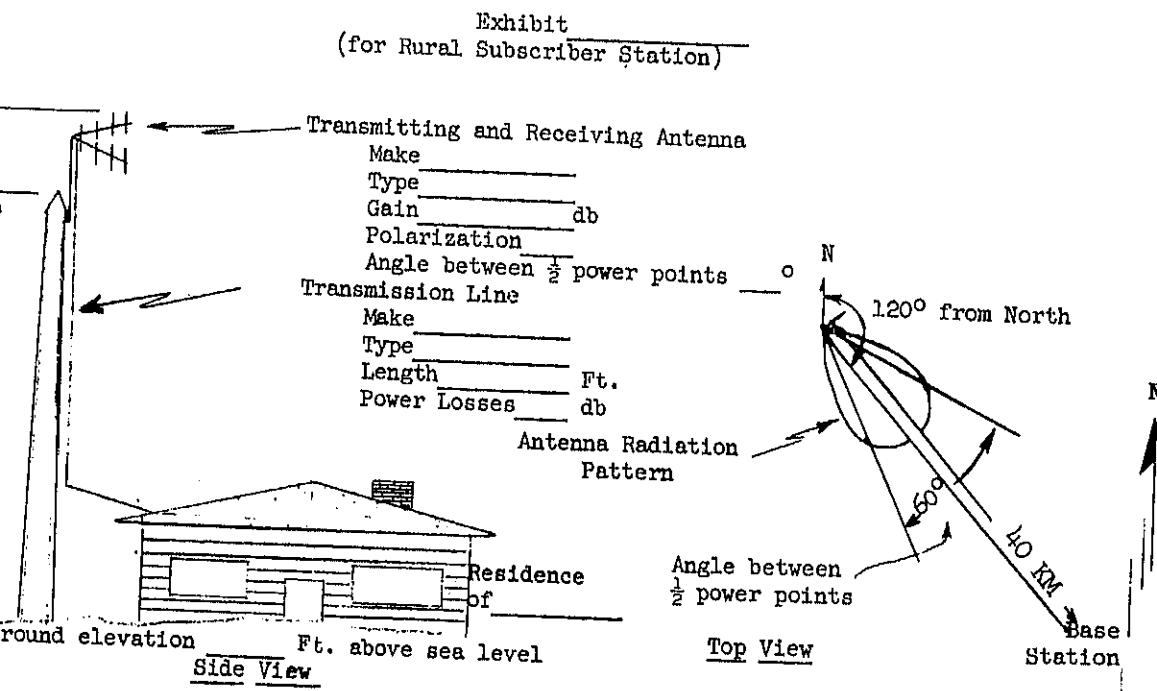
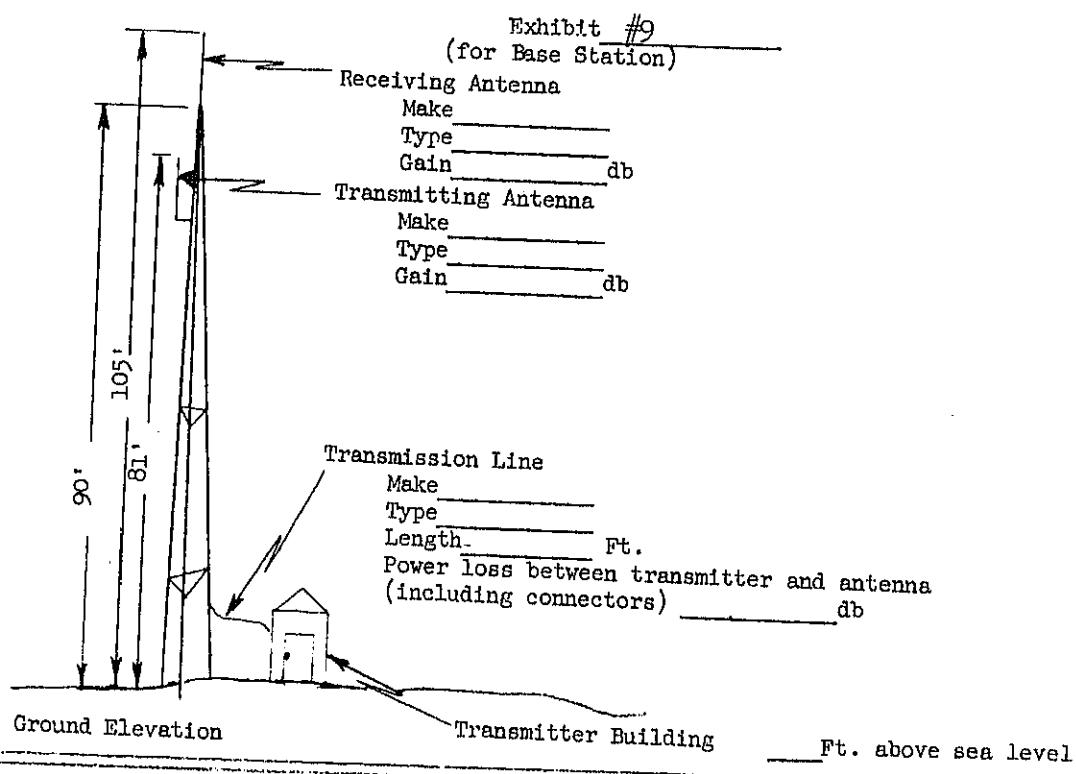
The transmission of the base station will be periodically monitored during the day by responsible personnel in radiotelephone-equipped company vehicles. Since all mobile and rural subscriber transmissions are retransmitted, they too will be monitored. The base station is taken off the air at the completion of a call by reception of a disconnect signal from the radiotelephone subscriber's station. If the base station fails to receive a disconnect signal at the completion of a call, a timer in the base station (which can be varied up to 5 minutes) will take the base station off the air.

If the station is not operating properly it can be disabled from further operation until corrections are made by opening the wire line control circuit either at the telephone exchange or at the base station.

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\*These explanations should be varied to conform to local circumstances and actual operation of the equipment to be installed.

APPENDIX IV - Continued  
SKETCH OF ANTENNA INSTALLATION

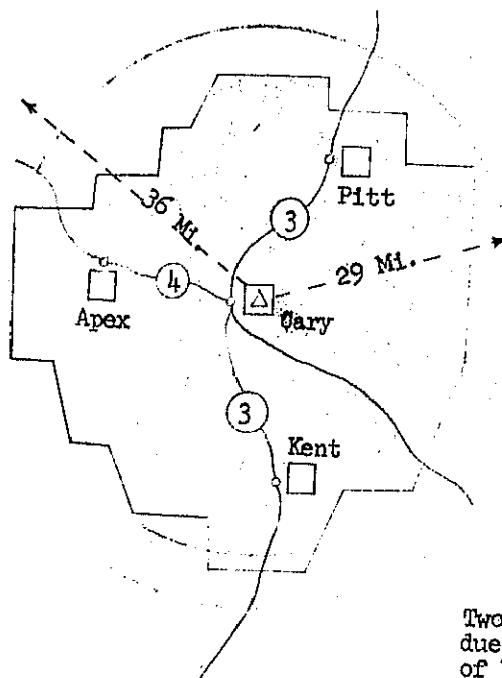


APPENDIX V

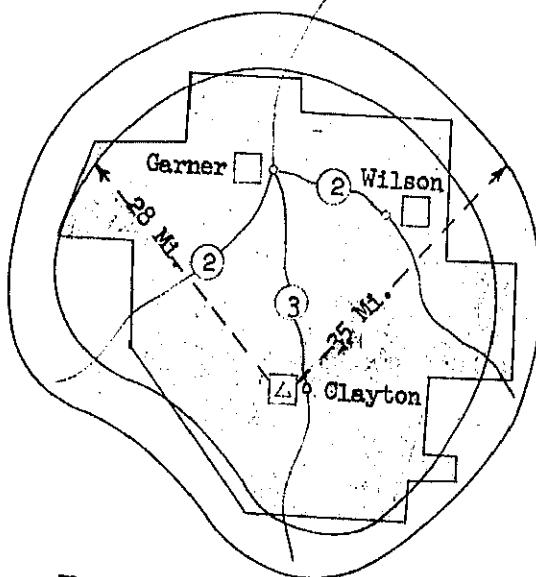
## EXAMPLES OF MOBILE RADIOTELEPHONE SERVICE AREAS

This appendix consists of diagrams outlining the franchised area(s) of the telephone borrower and shows the location of each central office owned by the borrower. Two circles or appropriately shaped patterns circumscribe the area(s) over which the radio system is designed to give satisfactory coverage. Information relative to the coverage is given in Figure 4 of Section 940. The legend shown at the bottom of the diagrams describes the manner in which this information should be shown. A section from a road map which can be obtained from an automobile service station should be used. This type of information should be submitted in the preloan procedure covered in REA Bulletin 385-1 and in the final proposal and contract. The equipment supplier(s) may prepare maps showing more detail with respect to areas of questionable service.

APPENDIX V - CONTINUED  
EXAMPLE NO. 2  
MOBILE RADIOTELEPHONE SERVICE AREA  
NORTH CAROLINA 000



Two base stations required  
due to geographical separation  
of borrower's franchised areas

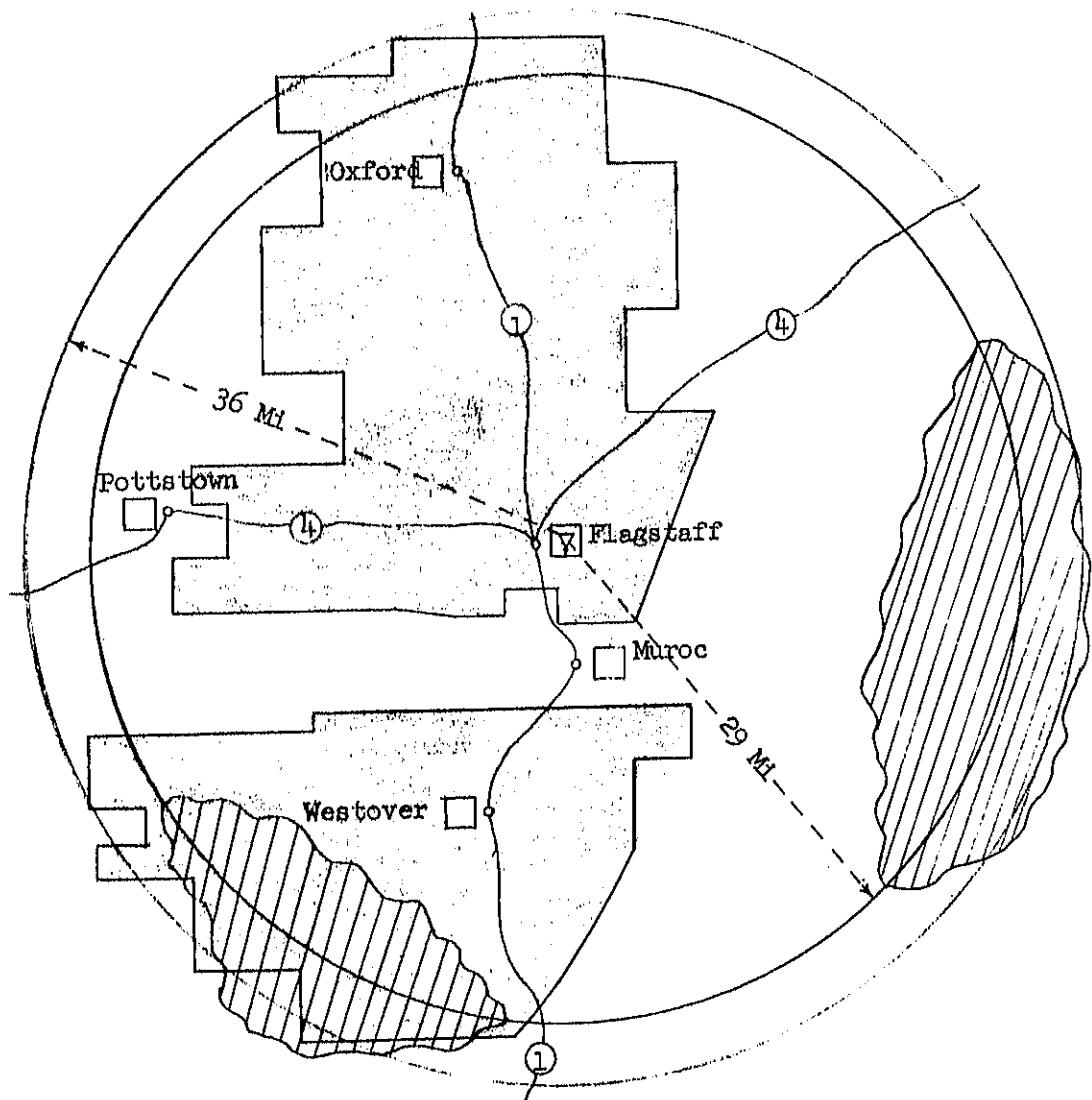


LEGEND:

- Approximate Boundary of Borrower's Franchised Service Area
- Highway Markers
- Base Station
- Community Dial Office

NOTE: Approximate Boundary of Radiotelephone Service Area  
1. Inner Curve: Area of Required Coverage (90 percent reliability)  
2. Outer Curve: Area of Poor Coverage (Subject to "dead" spots)

APPENDIX V  
EXAMPLE NO. 1  
MOBILE RADIOTELEPHONE SERVICE AREA  
NORTH DAKOTA 000



## LEGEND:

- Approximate Boundary of Borrower's Franchised Service Area
- Areas of Questionable Service Because of Terrain
- Highway Markers
- Base Station
- Community Dial Office

## NOTES:

Approximate Boundary of Radiotelephone Service Area

1. Inner Curve: Area of Required Coverage (90 percent reliability)
2. Outer Curve: Area of Poor Coverage (subject to "dead" spots)

APPENDIX VI

## CALCULATIONS FOR DETERMINING THE EFFECTIVE RADIATED POWER OF A BASE STATION AND ANTENNA SYSTEM

1. The nucleus of all mobile radiotelephone systems is the base station. The successful operation of a system depends primarily upon the proper design and installation of the base station antenna system.
2. The talkout range to the mobile units is dictated by the Effective Radiated Power from the base station antenna. The Effective Radiated Power is determined as follows:

$$\text{ERP} = P_t + G_a - L_c - L_m$$

Where ERP is the Effective Radiated Power,  $P_t$  is the rf output power of the base station transmitter,  $G_a$  is the antenna gain,  $L_c$  is the loss in the coaxial cable, and  $L_m$  is the miscellaneous losses due to the connectors and all other discontinuities in the antenna system.  $L_m$  should be low in a properly designed and constructed system; hence, this will be ignored in the calculations.

3. All quantities of rf power are expressed in dbm in keeping with telephone practice. The frequency used in all calculations is 160 MC.
4. The following examples illustrate the importance of using a low loss coaxial cable to increase the ERP rather than a higher powered base station transmitter.

A. 100 Watt Transmitter  
Typical Antenna150 feet of high loss  
coaxial cable (2.8 db/100 ft.)

$$\begin{aligned} P_t &= 50.00 \text{ dbm} \\ G_a &= \frac{6.00}{56.00} \text{ db} \end{aligned}$$

$$\begin{aligned} L_c &= 4.20 \text{ db} \\ \text{ERP} &= \frac{51.80}{\text{dbm}} \\ \text{or } 151 \text{ Watts} \end{aligned}$$

B. 50 Watt Transmitter  
Typical Antenna150 feet of low loss  
coaxial cable (0.55 db/100 ft.)

$$\begin{aligned} P_t &= 47.00 \text{ dbm} \\ G_a &= \frac{6.00}{53.00} \text{ db} \end{aligned}$$

$$\begin{aligned} L_c &= 0.82 \text{ db} \\ \text{ERP} &= \frac{52.18}{\text{dbm}} \\ \text{or } 165 \text{ Watts} \end{aligned}$$

SUMMARY OF A and B: 165 - 151 = 14 Watts

A comparison of the systems in A and B shows that the 50 watt transmitter using the low loss coaxial cable yields an ERP of 14 watts more than the 100 watt transmitter using the higher loss coaxial cable.

C. 100 Watt Transmitter  
Typical Antenna300 feet of high loss  
coaxial cable (2.8 db/100 ft.)

$$\begin{aligned} P_t &= 50.00 \text{ dbm} \\ G_a &= \frac{6.00}{56.00} \text{ db} \end{aligned}$$

$$\begin{aligned} L_c &= 8.40 \text{ db} \\ \text{ERP} &= \frac{47.60}{\text{dbm}} \\ \text{or } 57.5 \text{ Watts} \end{aligned}$$

D. 50 Watt Transmitter  
Typical Antenna

300 feet of low loss  
coaxial cable (0.55 db/ft.)

$$P_t = 47.00 \text{ dbm}$$

$$G_a = \frac{6.00}{53.00} \text{ db}$$

$$L_c = 1.65 \text{ db}$$

$$\text{ERP} = \frac{51.30}{1.65} \text{ dbm}$$

or 135 Watts

SUMMARY OF C and D: 135 - 57.5 = 77.5 Watts

A comparison of the systems in C and D shows that the 50 watt transmitter using the low loss coaxial cable yields an ERP of 77.5 watts more than the 100 watt transmitter using the high loss coaxial cable.

These examples illustrate that as the height of the antenna and length of coaxial cable increase, the use of a low loss coaxial cable becomes increasingly important.